WIRE AND WIRE PRODUCTS

OCTOBER 1950

One Name for all of the finest in cold drawing equipment!

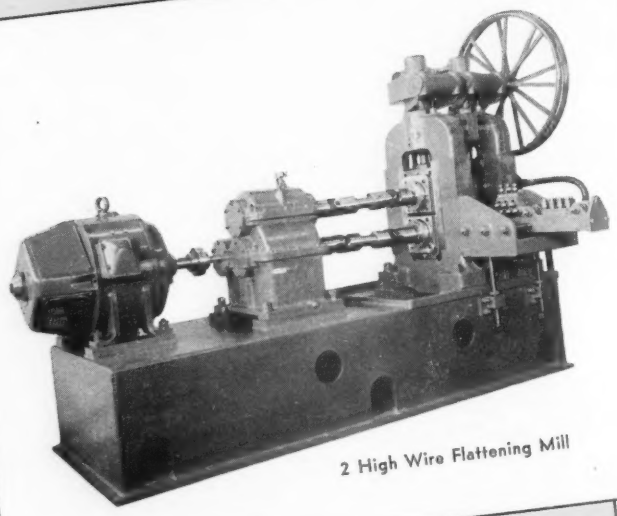
See pages 840 A, B, C, D

FICIAL PUBLICATION OF THE WIRE ASSOCIATION

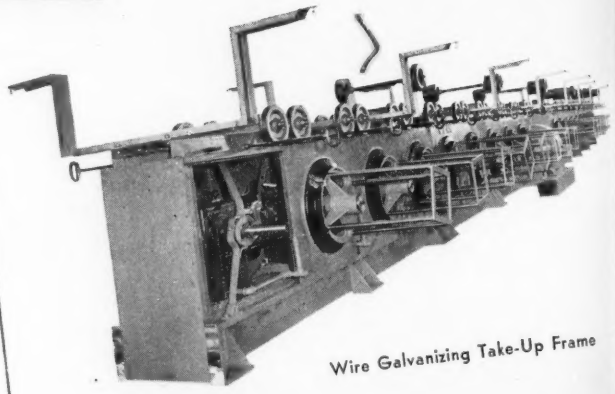
Wean

Equipment Corporation

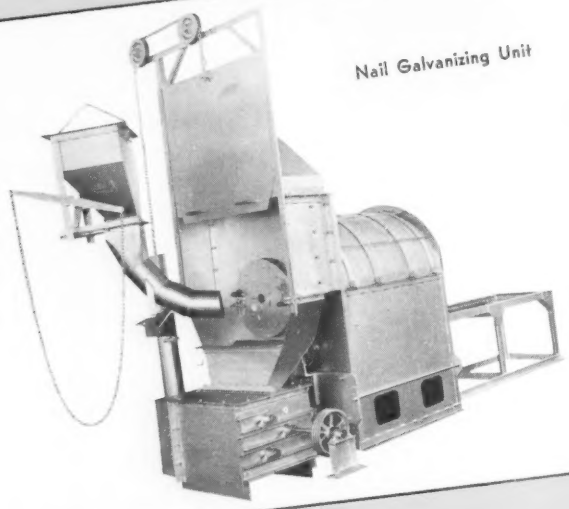
CLEVELAND, OHIO



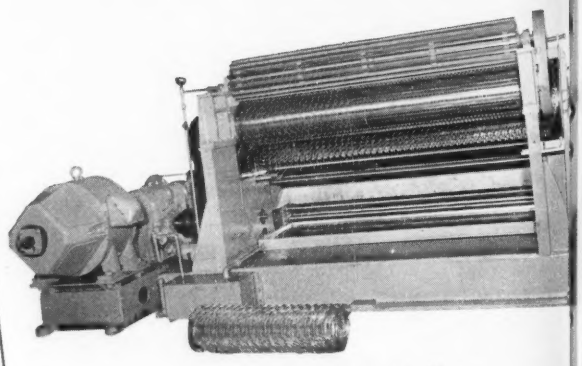
2 High Wire Flattening Mill



Wire Galvanizing Take-Up Frame



Nail Galvanizing Unit



Hexagon Netting Machine

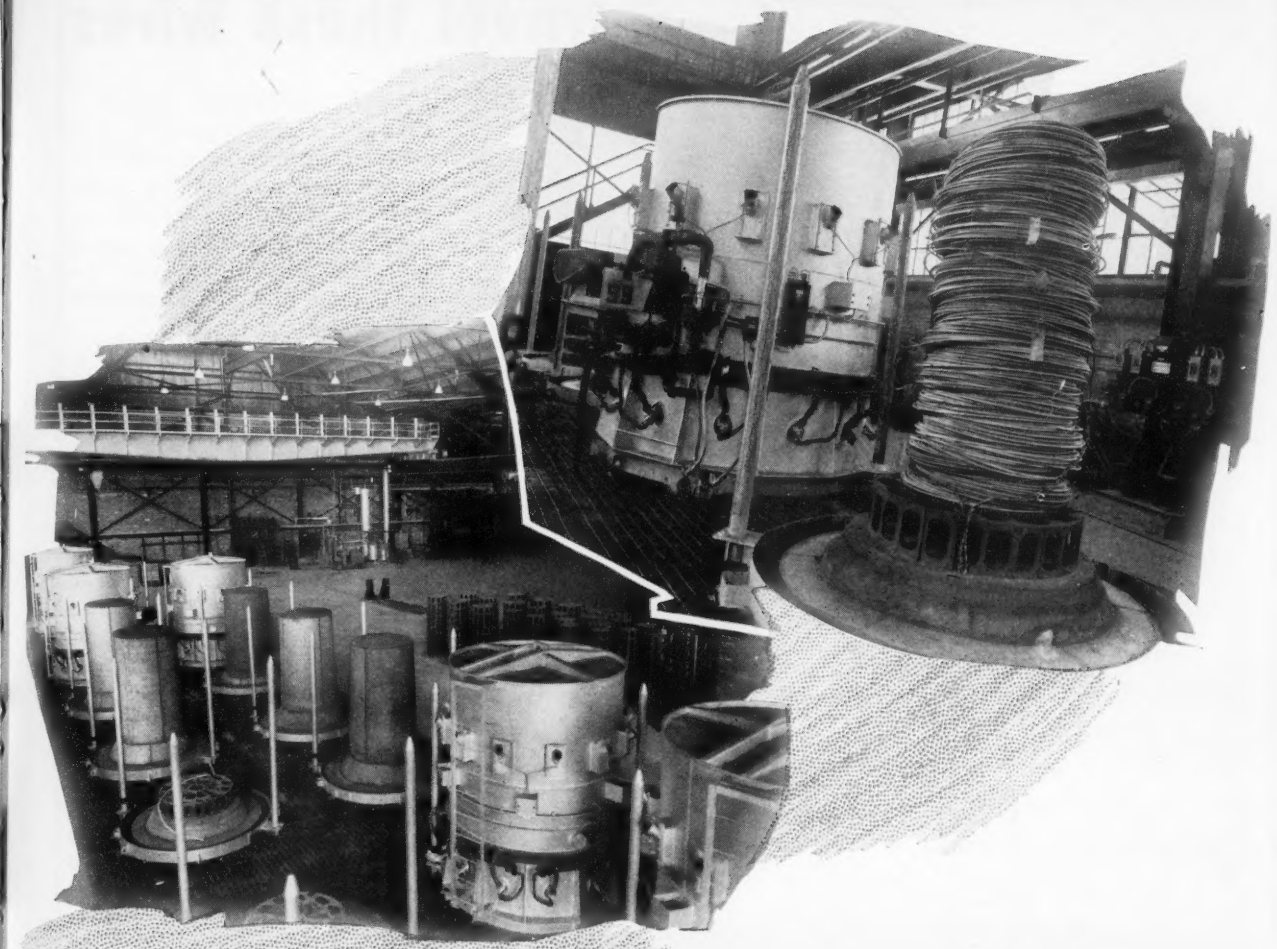
IN the past few years tremendous progress has been experienced in the field of wire machinery. Production speeds have been tripled and quadrupled. Product quality has been greatly improved. Machines have been made easier to operate and maintain.

THE Wean Equipment Corporation has been a large contributor to this advancement. Wean wire mill specialists have designed, built, and installed wire mill equipment for the leading wire producers the world over. If you make wire you should look to Wean for the best in machinery, service, and facilities.

LOOK TO WEAN FOR WIRE MACHINERY — PROCESS OR PRODUCT

WILSON

MERCHANT COIL ANNEALING FURNACES



THIS fine installation of 5 Wilson furnaces and 15 bases was installed in one of the newest merchant mills in the steel industry to anneal merchant bar coils in a controlled atmosphere without decarburization.

Lee Wilson

ENGINEERING Co., Inc.

20005 WEST LAKE ROAD • CLEVELAND, OHIO

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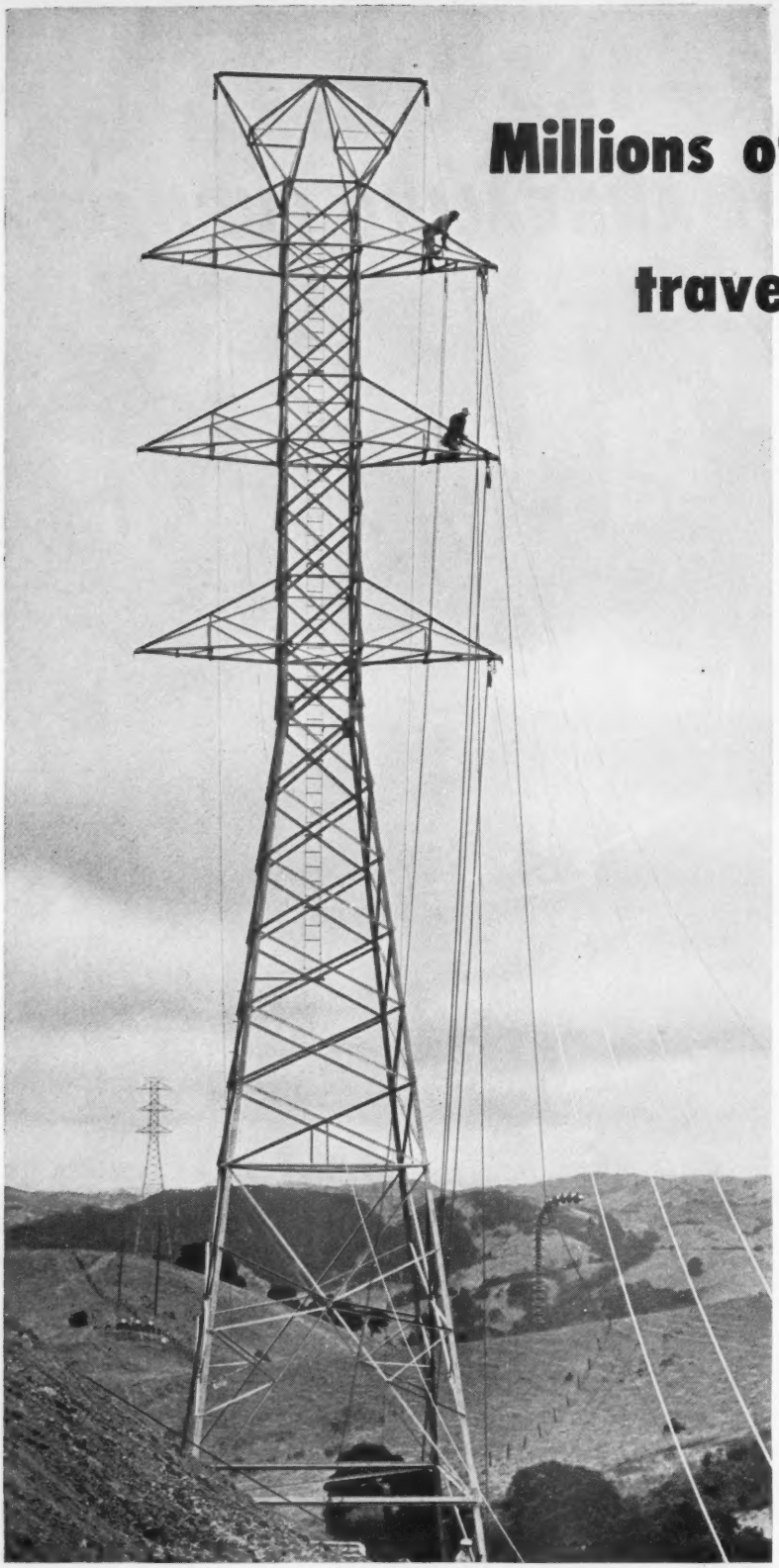
INDUSTRIAL FURNACES ★ RADIANT TUBE HEATING ★ HEAT TREATING PROCESSES



Millions of horsepower travel these wires

One of the most popular types of transmission wire for high-tension power lines is aluminum cable, steel reinforced—usually abbreviated to "ACSR". It has a core of galvanized steel wire to give it the high tensile strength necessary for this service.

Bethlehem makes a specialty of supplying ACSR core wire for power lines. We supply both bethanized and hot-galvanized finishes for this service. Bethanized wire is especially suitable because of its extremely tight bond of pure, corrosion-resistant zinc which is applied electrolytically, both in standard and heavy coating weights. Made to exacting specifications, ACSR core wire is used both as a single wire and as a strand which is then stranded with the aluminum wires. The finished product is strong, economical, and long-lasting.

We are continually developing many kinds of steel wire to suit special requirements and new uses, helping wire users to reduce costs and improve product performance. We'll gladly review any steel-wire problems that you may have right now. Our nearest sales office is always ready to assist you.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation.

BETHLEHEM WIRE

★ BETHLEHEM STEEL ★

WIRE & WIRE PRODUCTS, Vol. 25, No. 10, October, 1950. Publication Office at One Sherman Ave., Jersey City, N. J. Executive Office 300 Main Street, Stamford, Conn. Published monthly by the Quinn-Brown Publishing Corp., Richard E. Brown, President; R. S. Spengel, Secy. and Treas. Subscription price: U. S. $5.00; Canada, $5.00 per year; 50 cents per copy; Foreign, $7.50 per year. Entered as second class matter, January 10, 1949, at the Post Office, Jersey City, N. J., under Act of March 3, 1879.

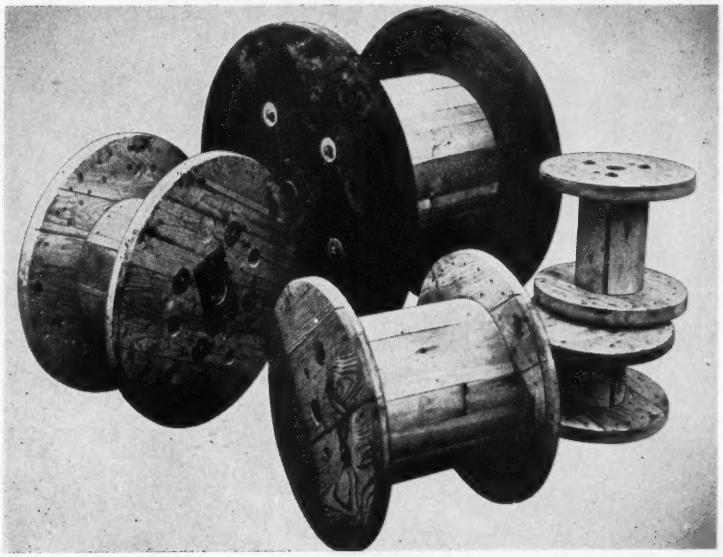
WOOD REELS RETURNABLE and NON-RETURNABLE

Bridge SHIPPING and SHOP REELS are furnished assembled or knocked down, made to your specifications. Built to withstand severest handling. Sturdy, strong, low in cost. Made for

CABLE,

ROPE and

WIRE



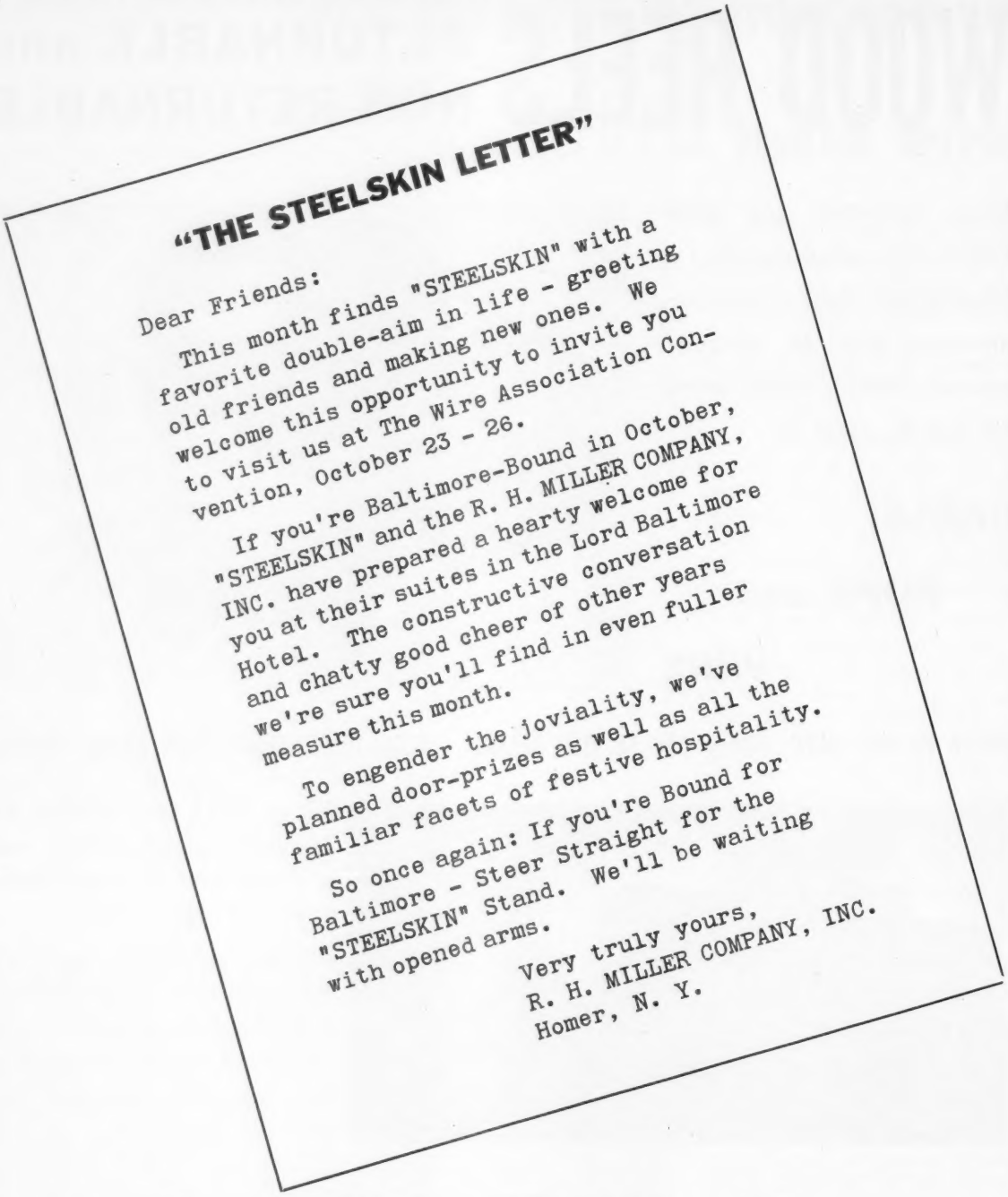
MADE IN ANY SIZE, FROM 12" TO 96" DIAM. ALSO REEL HEADS FOR STEEL DRUMS

Bridge REELS and SPOOLS are delivered anywhere within a radius of 200 miles of Hazardville by means of Bridge trucks.

This service includes over-night delivery of reels, in case of urgent need, direct to your plant. You are invited to avail yourselves of this unique and convenient service.

Send us your specifications and let us quote on costs.

BRIDGE MANUFACTURING CO.
HAZARDVILLE • CONNECTICUT


"THE STEELSKIN LETTER"
Dear Friends:
This month finds "STEELSKIN" with a favorite double-aim in life - greeting old friends and making new ones. We welcome this opportunity to invite you to visit us at The Wire Association Convention, October 23 - 26.
If you're Baltimore-Bound in October, "STEELSKIN" and the R. H. MILLER COMPANY, INC. have prepared a hearty welcome for you at their suites in the Lord Baltimore Hotel. The constructive conversation and chatty good cheer of other years we're sure you'll find in even fuller measure this month.
To engender the joviality, we've planned door-prizes as well as all the familiar facets of festive hospitality.
So once again: If you're Bound for Baltimore - Steer Straight for the "STEELSKIN" Stand. We'll be waiting with opened arms.
Very truly yours,
R. H. MILLER COMPANY, INC.
Homer, N. Y.

R. H. MILLER CO., Inc.

HOMER • NEW YORK

Soaps and Compounds for Dry and Wet Drawing of Ferrous and Non-Ferrous Wire, Tubing and for Deep Drawn Parts.

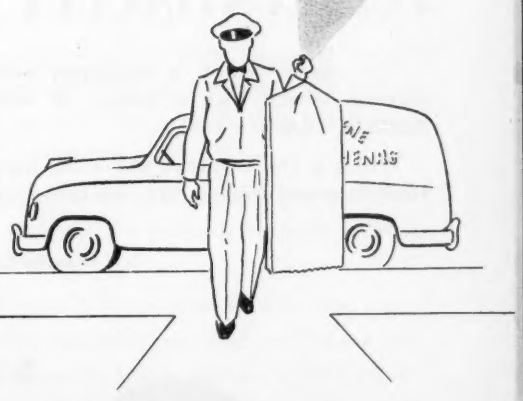
A REPUTATION HANGS-

ON MILLIONS OF THESE

CONTINENTAL STEEL CORP. STEEL CONTINENTAL WIRE KOKOMO, IND.

● Have you ever cursed a flimsy coat hanger? Then you can appreciate why so commonplace an item as a wire hanger is of critical importance to one of our customers. This particular manufacturer uses Continental Steel wire to make millions of coat hangers. His reputation—and ours—literally hang by this wire! We feel, therefore, the greatest responsibility toward our customer and his wire-fabricating problems.

There is this kind of "family" relationship between Continental and the hundreds of manufacturers we supply . . . whether they make coat hangers, fish hooks or gear shift rods. We act in the belief that business success ultimately depends on SERVICE . . . so you'll always find us ready and willing to help you. If you are troubled by a particular wire fabrication problem, please feel free to write us, without obligation.

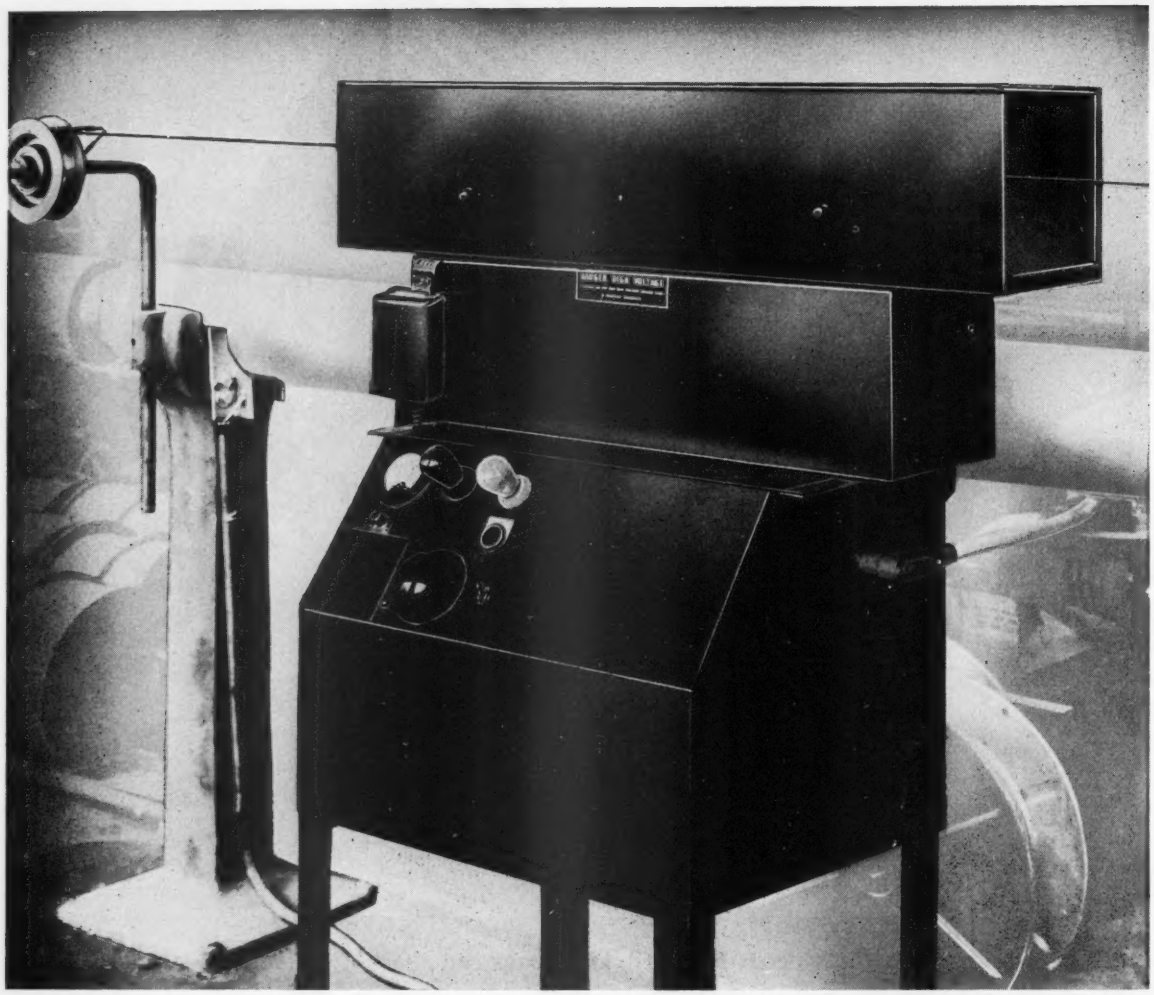


CONTINENTAL STEEL

CONTINENTAL STEEL CORPORATION

GENERAL OFFICES • KOKOMO, INDIANA

PRODUCERS OF *Manufacturer's Wire* in many sizes, shapes, tempers and finishes, including Galvanized, KOKOTE, Flame-Sealed, Coppered, Tinned, Annealed, Liquor Finished, Bright, Lead Coated, and special wire. ALSO, Coated and Uncoated Steel Sheets, Nails, Continental Chain Link Fence, and other products.



DAVIS SPARK TESTER INSTALLATION
FOR CONTINUOUS CURE AND PLASTIC EXTRUDER

The spark tester is equipped with a transformer which has a range of voltage from 3,000 to 16,000.

When a fault occurs the horn blows and the fault is registered on the resetable counter.

The fault relay will operate in less than 1/180th of a second and assures accurate location of the fault.

The operation of the Davis Spark Tester is not affected by wet wire.

Meets Underwriter's Laboratories' specifications for spark testing!

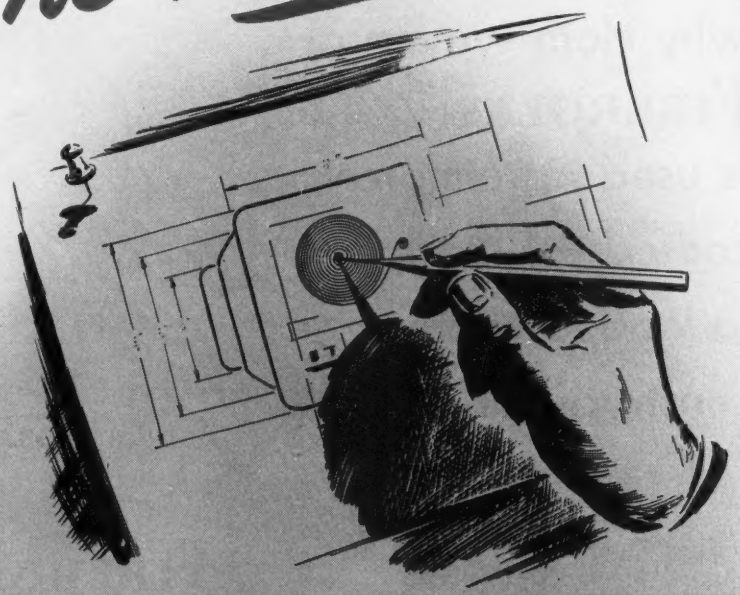
Write us today for detailed information!

DAVIS EQUIPMENT

THE R. L. DAVIS ELECTRIC CO., INC. • WALLINGFORD, CONN.

SPARK TESTERS • SPOOLERS • TAKE-UPS • CAPSTANS

Today it's Roebling!



Why production men choose Roebling Cold Rolled Spring Steel

IT'S BEEN PROVED in plants the country over . . . that Roebling Cold Rolled Spring Steel saves preparation time on machines, minimizes machine stoppages, and cuts down the number of rejects. And this is only natural! Every inch of Roebling Spring Steel is identical in gauge, grain and finish . . . meets users' specifications with absolute uniformity.

Roebling Cold Rolled Spring Steel is available annealed, hard rolled untempered; scaleless tempered; tempered and polished; tempered, polished and strawed; or tempered, polished and blued.

Your Roebling Field Man will gladly help you choose the cold rolled spring steel, or round, flat or shaped wire, that will improve your product and your production. John A. Roebling's Sons Company, Trenton 2, New Jersey.

ROEBLING *A CENTURY OF CONFIDENCE*

Atlanta, 934 Avon Ave. ★ *Boston,* 51 Sleeper St. ★ *Chicago,* 5525 W. Roosevelt Road ★ *Cincinnati,* 3253 Fredonia Ave. ★ *Cleveland,* 701 St. Clair Ave., N. E. ★ *Denver,* 4801 Jackson St. ★ *Houston,* 6216 Navigation Blvd. *Los Angeles,* 216 S. Alameda St. ★ *New York,* 19 Rector St. ★ *Philadelphia,* 12 S. Twelfth St. ★ *Portland,* 1032 N. W. 14th Ave. ★ *San Francisco,* 1740 Seventeenth St. ★ *Seattle,* 900 First Ave. S.

DO YOU KNOW

why cloth woven of FIBERGLAS* *Yarns* is used to reinforce coated cable tape in leaded cable construction?

FIBERGLAS *Yarns*

GIVE GREATER STRENGTH

SAVE SPACE, REDUCE WEIGHT
(allow thinner lead sheath)

RESIST ROT . . . ARE PERMANENT

ARE TEAR-RESISTANT

ARE LOW IN COST!

FIBERGLAS Yarns COST
LESS IN MORE AND MORE PLACES
100%
75%
50%
25%
1939 '40 '41 '42 '43 '44 '45 '46 '47 '48 '49
Percentage drop in the average cost of Fiberglas yarns since 1939

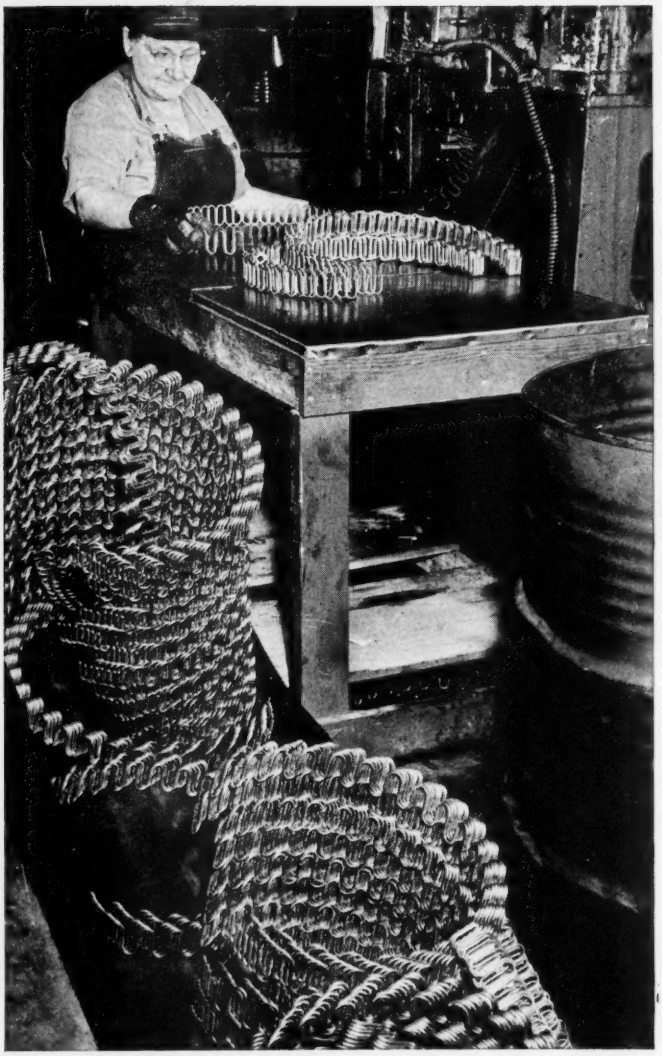
*Fiberglas is the trade-mark (Reg. U. S. Pat. Off.) of Owens-Corning Fiberglas Corporation for a variety of products made of or with glass fibers.

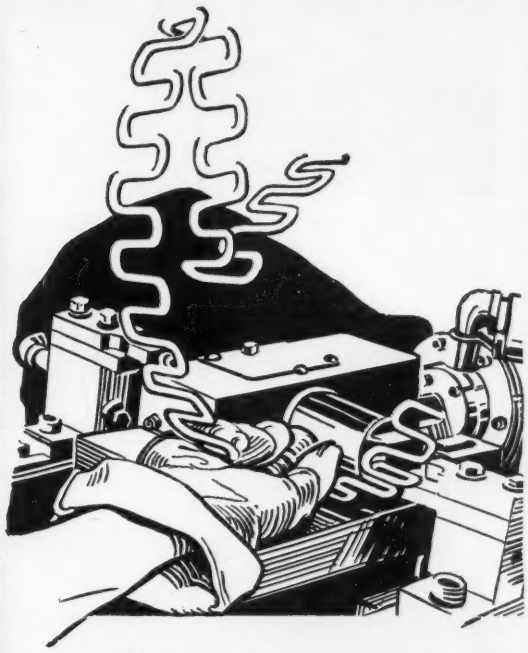
For complete information about Fiberglas yarn for this and other uses, write Owens-Corning Fiberglas Corporation, Electrical Sales Division, Dept. 875, 16 East 56th Street, New York 22, N. Y.

OWENS-CORNING FIBERGLAS *Yarns*

FIBERGLAS IS IN YOUR LIFE . . . FOR GOOD!

DUCTILITY





MANUFACTURERS of Ziz-Zag and No-Sag springs prefer Youngstown's Buckeye high-carbon (MB--equivalent) basic steel spring wire. It has the correct high-carbon content to provide adequate strength, balanced with the ductility and toughness it takes to speed the wire through intricate forming machines without a hitch.

Gage, temper and other physical characteristics run uniform--the chemistry is subject to close control from pouring of the ingot to drawing of the wire.

Youngstown's Buckeye high-carbon basic steel spring wire is produced in a wide range of grades and gages. Write or phone the nearest Youngstown District Office for further information.

Youngstown

THE YOUNGSTOWN SHEET & TUBE CO. 1900 YOUNGSTOWN 1950 50 YEARS OF SERVICE

STEEL SPRING WIRE

THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of Carbon, Alloy and Yoloy Steel

General Offices — Youngstown 1, Ohio

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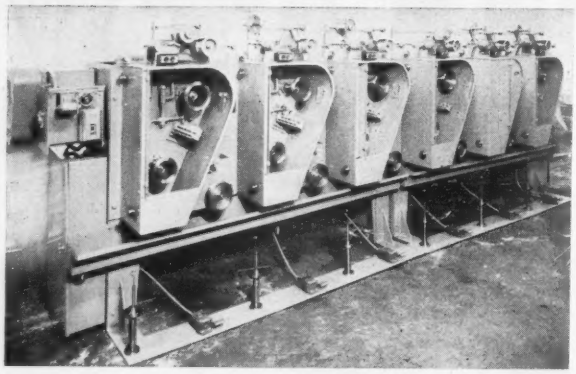
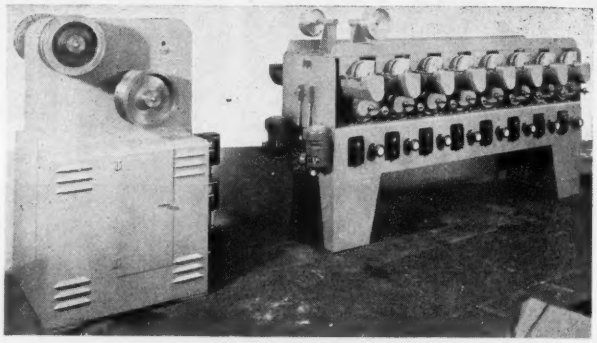
WIRE - ELECTROLYTIC TIN PLATE - COKE TIN PLATE - PIPE AND TUBULAR PRODUCTS - HOT AND COLD FINISHED CARBON AND ALLOY BARS - RODS - SHEETS - PLATES - CONDUIT - RAILROAD TRACK SPIKES.



No. 934—Six Unit Fine Wire Drawing Machine



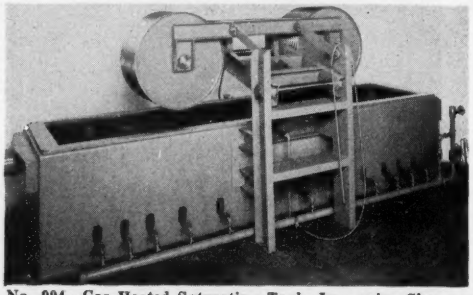
No. 966—Torque Motor Take-Up with Capstan

EST. 1855 AIMco INC. 1915

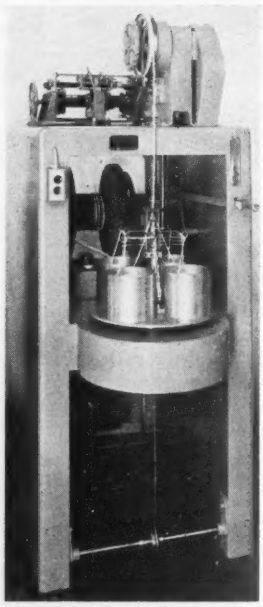
"American" AIMco INSULATING MACHINERY COMPANY

REG. U.S. PAT. OFF.

517 West Huntingdon St.
Zone 33
PHILADELPHIA PENNSYLVANIA U.S.A.



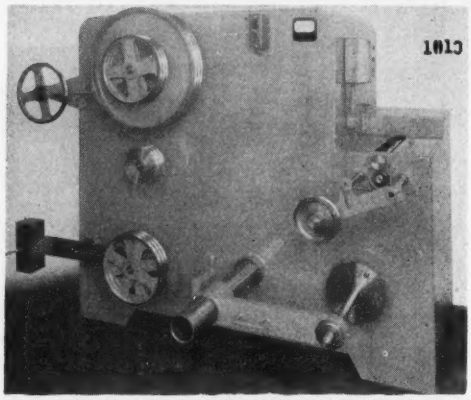
No. 994—Gas Heated Saturating Tank, Immersion Sheaves Equipped with Hydraulic Lift and Let Down.



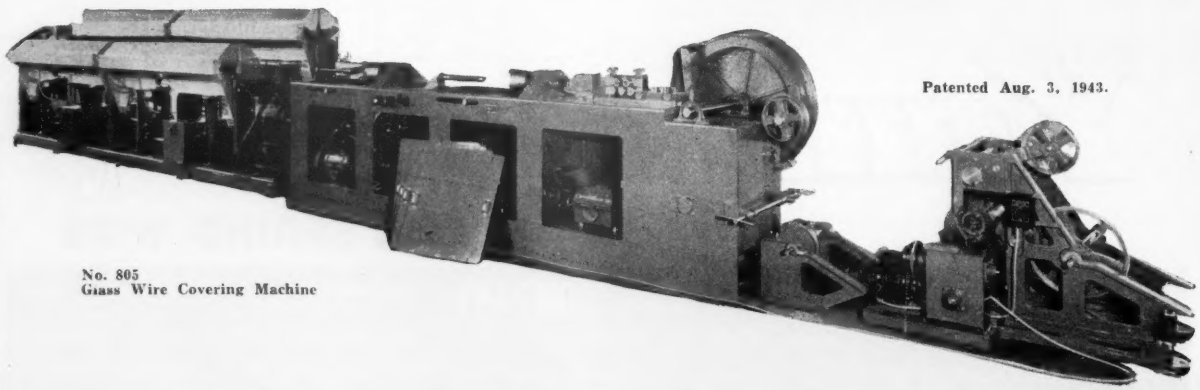
No. 974—Asbestos Serving Machine for Heater Cord.

WE SPECIALIZE IN MACHINERY FOR:

WIRE DRAWING
ENAMELING
TINNING
WINDING
INSULATING
TAPING
GLASS-COVERING
PANNING
AND ALLIED MACHINERY

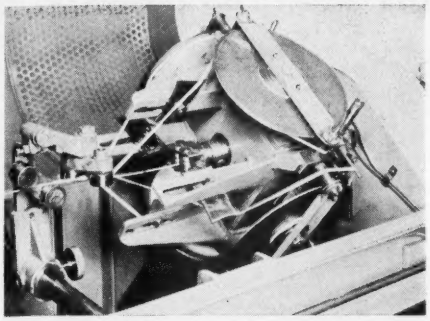


No. 1013—Capstan and Take-Up Reel-Stand. Constant Speed, Constant Tension Throughout Reel Build-Up. For Use Behind Extruding Machines.

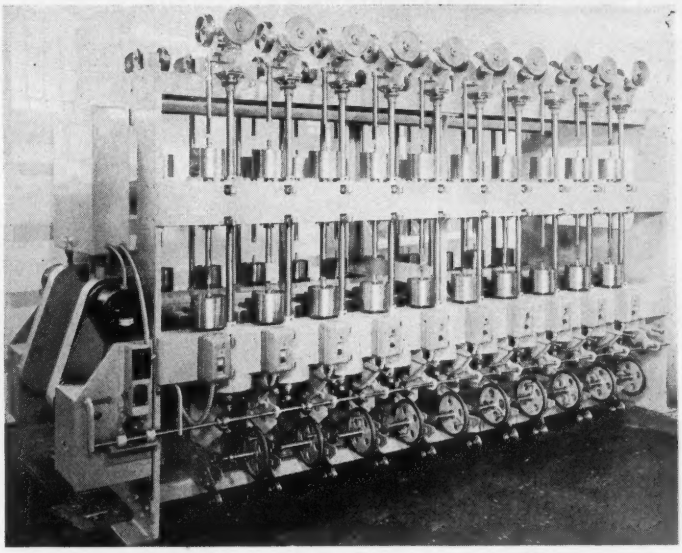


Patented Aug. 3, 1943.

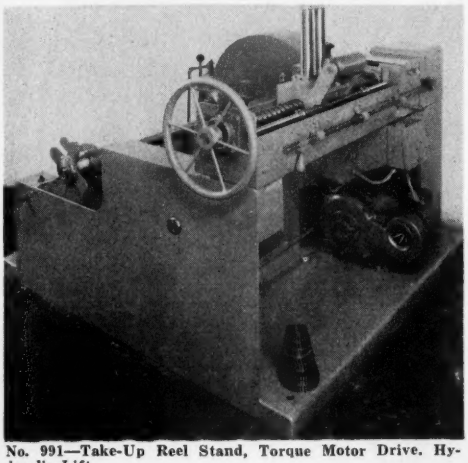
No. 805
Glass Wire Covering Machine



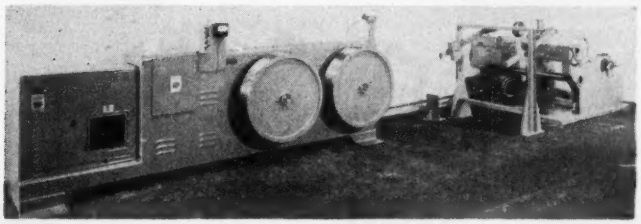
No. 889—Quadruple Taping Head



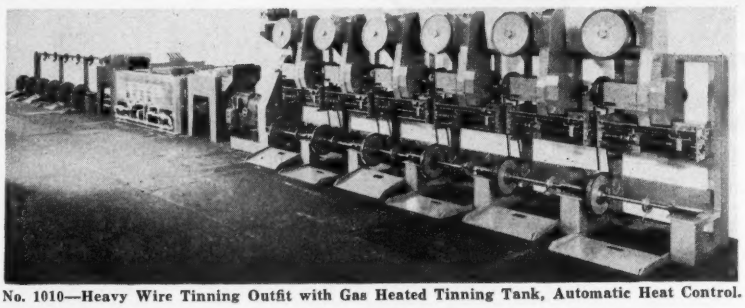
No. 957—Model 1-D-20 MBB Insulation Winding Machine



No. 991—Take-Up Reel Stand, Torque Motor Drive. Hydraulic Lift.



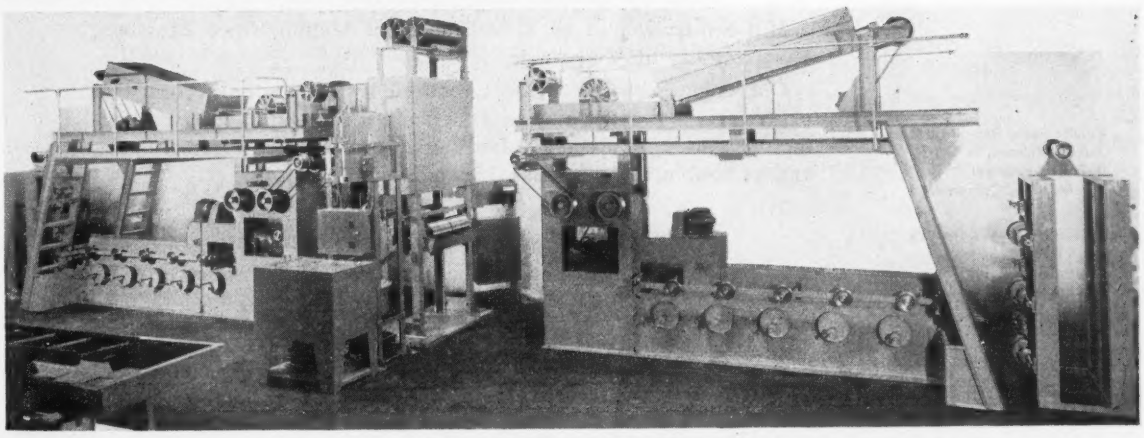
No. 1017—Double Capstan with Variable Drive; Take-Up Stand with Controlled Drive Providing Constant Tension Throughout Reel Build-Up. For Use Behind Extruding Machines.



No. 1010—Heavy Wire Tinning Outfit with Gas Heated Tinning Tank, Automatic Heat Control.

FOR ADDRESS:

SEE OPPOSITE PAGE



No. 997—Enameling Machine with Pre-Annealers and Storage Circulating and Filter System for Enamel. Oven Higher than Indicated, Shortened to Illustrate Top Sheaves.

Welcome to members and guests of The Wire Association

Here's your best buy in REELS and SPOOLS

- APCO MOSSBERG STEEL REELS for steel and copper wire and wire rope.
- APCO MOSSBERG STEEL SPOOLS for processing and shipping wire.

If it can be wound on a reel, spool or bobbin, Apco Mossberg Company can fill your needs.

Our engineering department, backed by over a half-century of experience, is at your service. Our plant is fully equipped to manufacture almost any conceivable kind, type and size of steel spool, reel or bobbin, in large quantities or small.

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Write for illustrated brochure containing useful information on our spool and reel products.

Manufacturers of steel spools and reels for over 55 years

APCO MOSSBERG COMPANY

(The original Frank Mossberg Co.)

ATTLEBORO, MASSACHUSETTS, U.S.A.

Standard LEADS AGAIN!

PRESENTING a New Lubricant Coating for Use on ROD BOLT and RIVET STOCK

NO LUBRICANT OF ANY KIND USED IN THE DIE BOX

A new and different lubricant coating (Patent Pending) has been developed for use on rods for the drawing of bolt and rivet stock. After more than a year of testing and trial and with many hundreds of tons of rods drawn and formed into bolts and rivets, we are prepared to offer this compound to the trade. There are many advantages to be gained from this compound that are enumerated below:

1. Rods are coated and lubricated in the cleaning house in one solution.
2. Dried either in baker or air-dried.
3. Non-hygroscopic.
4. One coating satisfactory for all types of bolts and rivets.
   - A. Single Extrusion.
   - B. Double Extrusion.
   - C. Swaging.
   - D. Bolt Machines.
   - E. All types of rivets.
5. Elimination of the use of oil on bolt machines with the possible exception of the trimmer die.
6. Increased life in header dies, trimmer dies and kick out pins.
7. Less Cost.

Call or Write Headquarters or Any Standard Service Center:

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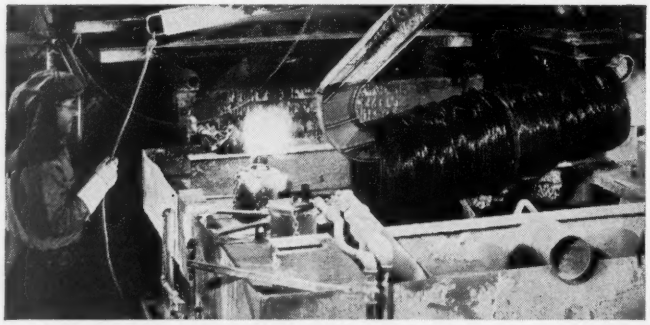
STANDARD INDUSTRIAL COMPOUNDS COMPANY has pioneered most of the outstanding contributions to better wire drawing through better lubricants. Consult with STANDARD for the solution of your difficult problems.

wire drawing lubricants *Standard* INDUSTRIAL COMPOUNDS CO., INC.

4600 WEST FERDINAND STREET
CHICAGO 44, ILLINOIS

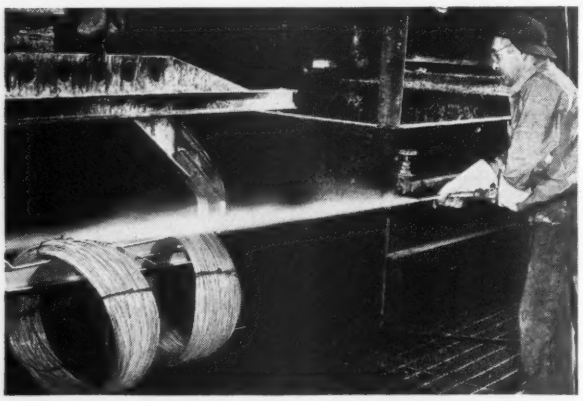
AUDUBON WIRE CLOTH gets speedy descaling of precision drawn wire—with no metal loss!

Du Pont Sodium Hydride Descaling Process Cleans Work Quickly and Efficiently--- Saves Metal, Time, Space, Equipment and Materials



Operator removes stainless steel wire from descaling bath—ready for quench, brightening and high pressure rinse.

The production of high grade wire for industrial screen cloth and continuous Flexible "Metalwove" Belts calls for clean, scale-free rod and wire. For this reason, in 1946, the Audubon Wire Cloth Corporation of Philadelphia installed a Du Pont Sodium Hydride Descaling Bath to clean thoroughly its stainless and alloy rod and wire of all sizes . . . easily, quickly and economically.

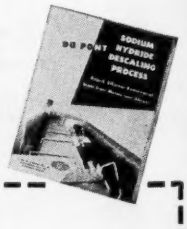


High pressure rinse completes the scale removal job.

Because the bath action stops when the scale has been penetrated down to the base metal, Audubon finds that its precision drawn wire can be descaled at the various sizes during processing without metal loss. This speedy cleaning method (work is in the bath only 15 to 20 minutes) has permitted cleaning time to be cut substantially. And, to speed production further, different metals can be handled simultaneously!

The bath is operated at 700° F. in a carbon steel tank, intermittently or continuously as the work demands. The compactness of the equipment, including the quench and rinse areas, permits a large volume of work to be handled in a relatively small space.

The success which the Audubon Wire Cloth Corporation and many other firms have had with this speedy, efficient descaling method may point the way to increased production and better products in your plant. For complete information about the process, mail the coupon below. It will bring you promptly a copy of "Du Pont Sodium Hydride Descaling Process" which tells how easily it can be installed to handle a wide range of work.



Tune in Du Pont "Cavalcade of America" Tuesday nights—NBC coast to coast

DU PONT
Sodium hydride process for positive descaling

DU PONT
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

E. I. du Pont de Nemours & Co. (Inc.)
Electrochemicals Department
Wilmington 98, Delaware

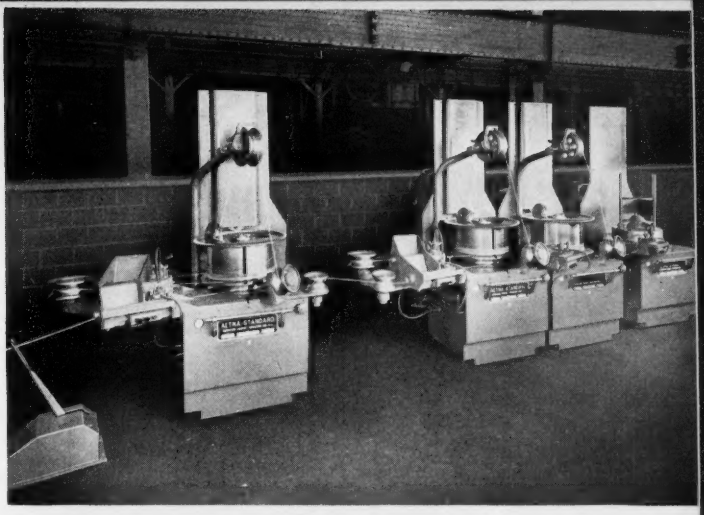
Please send my copy of "Du Pont Sodium Hydride Descaling Process."

Name _____

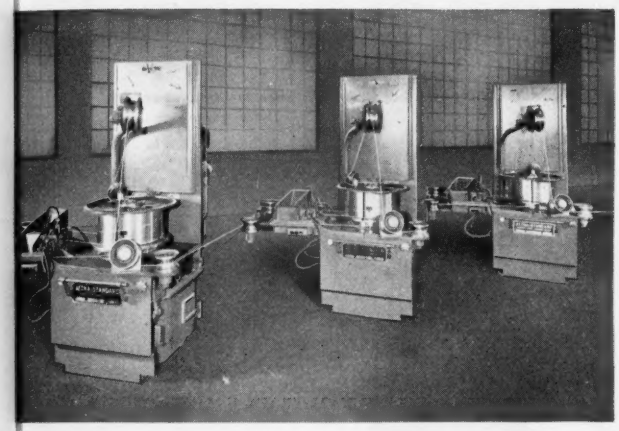
Firm _____

Position _____

Address _____



aetna-standard wire drawing unit



SIGNIFICANT ADVANTAGES AND FEATURES

1. Compactness and sturdy construction with vertical block and vertical motor on each unit.
2. Unit parts can be interchanged.
3. Vertical motors easily accessible and interchangeable.
4. Controlled, effective water-cooling of blocks and dies.
5. Practical versatility by tandem combinations of two or more Units of the same or different size.
6. Full speed range of each Unit motor always available with the unique auto-rheostatic synchronizing control mechanism.
7. Automatic control of reserves of wire on intermediate Units, offers these advantages:
   (a) additional cooling time and effect between drafts.
   (b) eliminates peripheral slippage of wire on blocks.
   (c) broken intermediate wires can be welded easily.
   (d) reduces wire breakage during starting or acceleration.
   (e) avoidance of extreme sensitivity in auto-rheostatic control.
8. Insurance against obsolescence—Aetna Units can be regrouped by addition of single Units, multi-Units or divisions of multi-Units to keep pace with future wire production or market demand.

UNIT SIZES	BLOCK DIAMETERS		
No. 30	26"	30"	36"
No. 22	16"	22"	26"
No. 16	12"	16"	22"
No. 12	8"	12"	16"

ASSOCIATED COMPANIES

Head Wrightson Machine Company, Ltd., Middlesbrough, England—Great Britain, Finland, Sweden, Norway, Denmark, Union of South Africa, Northern and Southern Rhodesia.

Aetna-Standard Engineering Company, Ltd., Toronto, Ontario, Canada.

M. Castellvi, Inc., New York, N. Y.—Mexico, Central and South America.

Societe de Constructions de Montbard, Paris, France—France, Belgium, Holland, Luxembourg, Switzerland.

Compagnia Italiana Forme Acciaio, Milano, Italy—Italy.

Aetna-Japan Company, Ltd., Tokyo, Japan—Japan.

Hale & Kullgren, Inc., Akron, Ohio—Representative for the Rubber Industry.

Designers and Builders to the Ferrous, Non-Ferrous, Leather and Rubber Industries

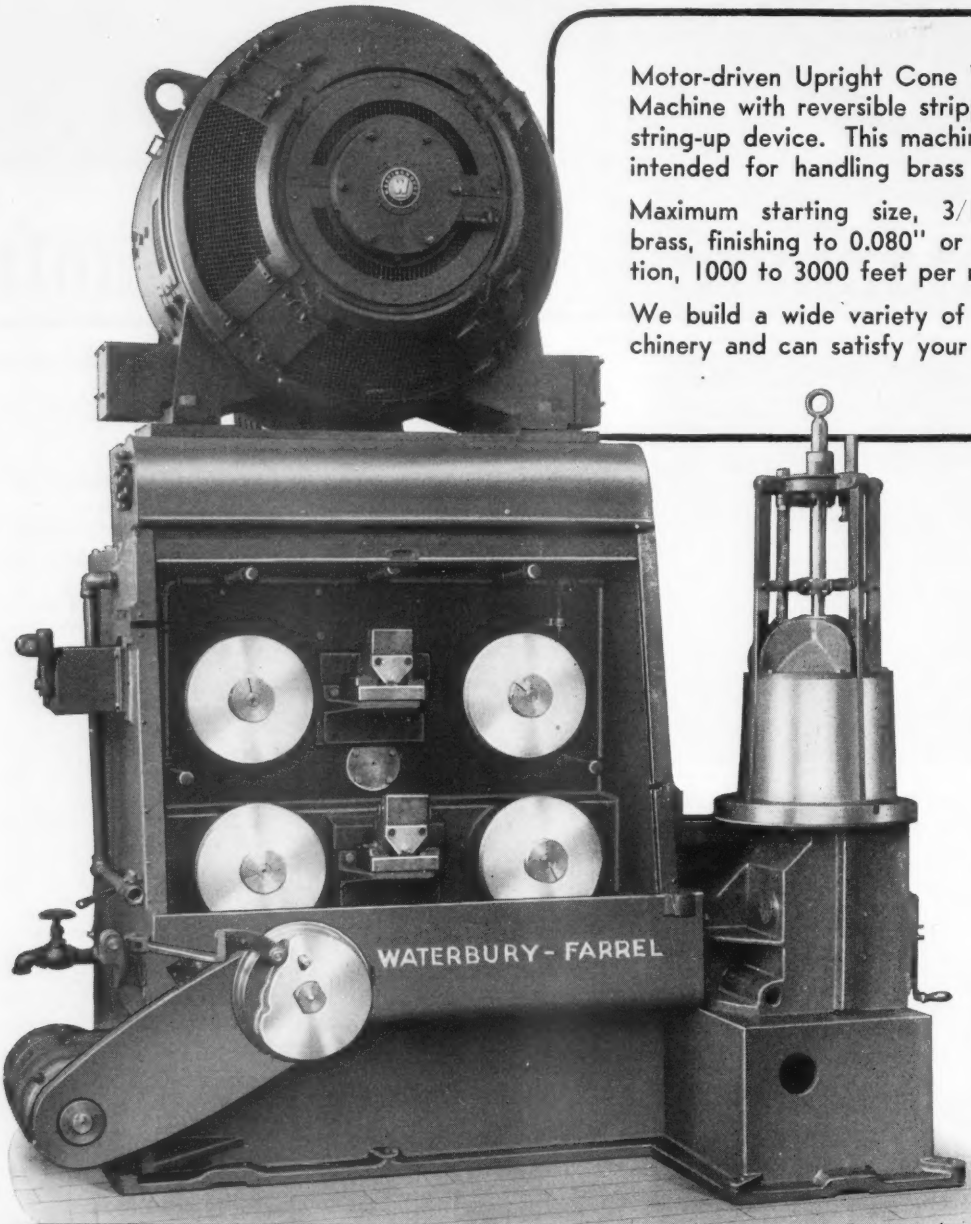
aetna-standard

THE AETNA-STANDARD ENGINEERING COMPANY . YOUNGSTOWN, OHIO

Plants in Warren, Ohio . Ellwood City, Pennsylvania

Just one in a wide variety of . . . .

WIRE DRAWING MACHINES



Motor-driven Upright Cone Wire Drawing Machine with reversible stripper block and string-up device. This machine is primarily intended for handling brass wire in coils.

Maximum starting size, 3/16" annealed brass, finishing to 0.080" or less. Production, 1000 to 3000 feet per minute.

We build a wide variety of wire mill machinery and can satisfy your requirements.

FOUNDED WATERBURY FARREL 1851

THE WATERBURY FARREL FOUNDRY & MACHINE COMPANY

WATERBURY, CONNECTICUT, U.S.A.

CHICAGO CLEVELAND NEWARK, N. J.

A NEW AND IMPROVED TYPE OF CABLE CORD

FOR YEARS cable makers have formed wire ropes around a center cord. This core serves as a cushion to hold the wires apart during flexing. It also serves as a reservoir for lubricants, and oils the wires every time it's squeezed.

At first these cable cords were made of imported fibres from the other side of the world. These foreign fibres came in short lengths. They were bunchy and irregular. Frequently they were scarce, and their prices skyrocketed.

Now you'll see an increasing number of steel cables with center cords made by Twitchell from American kraft fibre. The Wire Rope Corporation of America is a typical user and has been buying our fillers for years for use in automobile tow cables.

Twitchell's kraftcord cable-fillers are highly uniform in diameter. They can be supplied in "endless" lengths that make possible continuous manufacturing. For example, a popular size of filler for use in the wire rope industry is 3/16". Twitchell makes this in standard 15,000-foot endless length reels.

Twitchell wire rope cores are flexible, smooth, easy to handle. They are coated with hot wax at the Twitchell plants, arriving at your plant ready for further coating with petrolatum or other materials.

If you're looking for ways to streamline your manufacturing with uniform endless materials, let one of our men talk to you about Twitchell cores. They're made to precise standards and to your specifications. They're always available. Their prices are fair.

If you'd like the names of men you know who are using Twitchell cable cords, if you'd like to see samples and photographs of wire rope, tow cable, and other wire products built around Twitchell cords, or if you'd like samples of the cords themselves, write us or telephone us. E. W. TWITCHELL, INC., Third and Somerset Streets, Philadelphia 33, Pa.

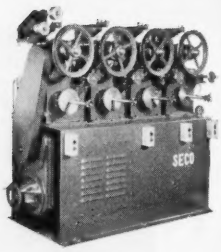
TWITCHELL

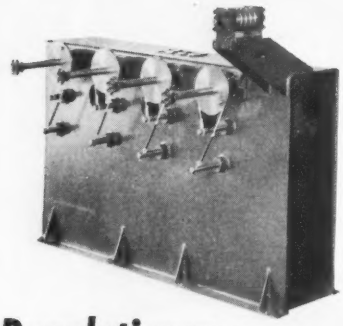
Paper Products for the Wire Industry

TWISTED
FOLDED
PRESSED
CRUSHED
SHAPED
BRAIDED
WOVEN

New SECO Gang Wire Spooler...

Draws to Size and Spools in ONE Operation!





Revolutionary SECO *Spooler Features:*

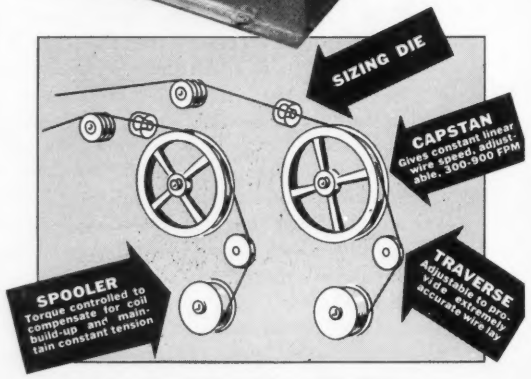
1. **Constant Linear Spooling Speed**
2. **Automatically Controlled Tension**
3. **Adjustable, Accurate Traversing**

PLUS **..A Final Draw To Finished Size**

This new SECO Gang Spooler can eliminate all of your spooling headaches. Linear wire speed is fully controlled by adjusting capstan speed. Hydraulic torque control of the spooling mechanism accurately maintains constant wire tension at a pre-set value . . . and automatically slows down the spooler to compensate for coil build-up. The hydraulically-operated traverse can be adjusted over a wide range. It maintains an accurate wire lay to a split-thousandth.

In addition to these unusual features this new SECO Spooler makes a final finishing and sizing draw through a carbide die . . . an extra feature that is typical of efficient SECO designs.

Write today for full information, or assistance with your spooling problem. Our engineers are ready to help you at any time — with no obligation to you.


SIZING DIE
CAPSTAN
Gives constant linear wire speed, adjustable, 300-900 FPM
SPOOLER
Torque controlled to compensate for coil build-up and maintain constant tension
TRAVERSE
Adjustable to provide extremely accurate wire lay

SHOWN ABOVE is the drawing and spooling arrangement. Copper wire from the tinning bath is drawn through sizing dies to accurately finished sizes of .035" to .050". A Reeves variable speed transmission driven by a 5 hp. AC motor adjusts capstan speed to provide 300-900 FPM linear wire speeds. The hydraulic motors driving the spoolers are torque-controlled to provide constant tension and constant linear spooling speed. Tension is fully adjustable over a wide range. Spools from 25 to 65 pounds of wire.

SECO STEEL EQUIPMENT CO.

2890 EAST 83rd ST. • CLEVELAND 4, OHIO

Metal men have many reasons for using HOUGHTO-DRAW 357...

...this man likes the bright finish it provides

...this man likes the way it steps up production

...this man likes the cleaner tanks and lines (as compared to lime)

...this man likes its low cost per ton of steel drawn

...this man likes its ability to handle so many different jobs

Houghto-Draw 357 was developed as a superior drawing lubricant for bars and rods. It is in paste form, and contains waxes, fats and colloidal pigment, with an extreme-pressure additive.

It is recommended for cold drawing of hot or cold rolled bars or rods, particularly as a replacement for lime, being cleaner and providing a brighter finish. It's being used for cold-heading too, and for tube drawing.

Solutions come up to heat quicker because heating coils stay clean. No re-dip is necessary, as the coating is adhesive.

This drawing aid has been used in production for over a year without dumping the tank. For sheet drawing and stamping there are other Houghto-Draws that will step up production. May we demonstrate?

E. F. HOUGHTON & CO.
303 W. Lehigh Ave., Phila. 33
Fisher Bldg., Detroit

Houghton products for the metal-working industry include:

HEAT TREATING SALTS ... QUENCHING OILS ... CLEANERS ...
CUTTING OILS ... RUST PREVENTIVES ... INHIBITORS ...
"FORTIFIED" LUBRICANTS ... PACKINGS AND LEATHER BELTING

7 Reasons why mills use Talide Rolls

Talide Work Rolls

Solid Carbide Rolls
(weighing up to 1000 pounds)
for Strip or Sheet

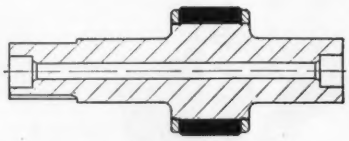
1. MORE PRODUCTION
2. BETTER FINISH
3. HIGHER SPEEDS
4. LESS DOWN TIME
5. CLOSER TOLERANCE
6. GREATER REDUCTION
7. FEWER REJECTS

● Profitable, increased tonnage with Talide Carbide Rolls can be had Mills regularly report astounding new figures. What's more, increased operating speeds and improved surface finish make subsequent polishing and buffing unnecessary.

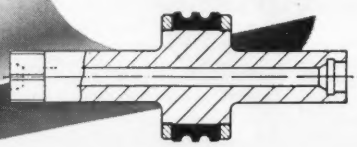
Talide Tungsten Carbide Rolls are used for ordinary finish or mirror-finish on such items as cold rolled stainless, spring steel, razor steel, alloys, carbon, aluminum foil, tinsel ribbon and flat wire.

Metal Carbides Corporation originally developed the art of making Carbide Rolls, and only this firm makes solid or sleeved Talide Carbide Rolls weighing up to 1000 pounds. Available in diameters up to 10″ and lengths up to 40″. We make the smallest and largest rolls in the world!

Write us today. We'll show you how to get *more production, better finish, higher speeds, less down time, closer tolerances, greater reductions* and *fewer rejects* on your mill operations



Sleeved Rolls for Flat Wire



For Shape Wire

SINTERED CARBIDES
METAL CARBIDES CORPORATION
MC TALIDE
YOUNGSTOWN, OHIO
HOT PRESSED CARBIDES

METAL CARBIDES CORPORATION

YOUNGSTOWN 5, OHIO *Pioneers in Tungsten Carbide Metallurgy*

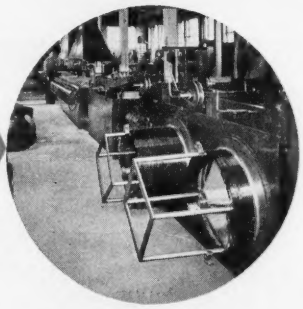
CUTTING TOOLS · DRAWING DIES · WEAR RESISTANT PARTS

THE *Trauwood* PROCESS IS SETTING A NEW "WIREBOUND" TRADITION!!

QUALITY, UNIFORMITY, LOW-COST OPERATION

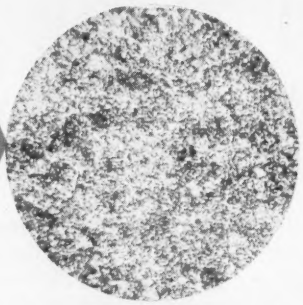
★ The electric resistance heating used in our process is over 90% efficient and results in a uniformly heat treated product plus the ability to duplicate exact heating and quenching cycles from day to day. Positive circulation in the molten metal quench bath insure absolute uniformity of the wire.

FASTER PRODUCTION FULLY AUTOMATIC



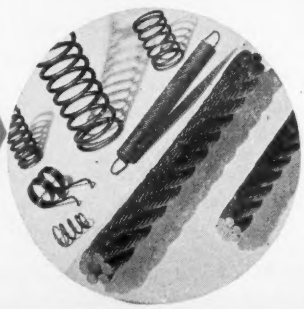
★ The TRAUWOOD process is much faster than ordinary furnace heating due to the very rapid rate of electric resistance heating. The equipment is entirely automatic and is easy to operate. Greater production with a material reduction in pickling and cleaning costs is insured.

BROAD THERMAL RANGE ACCURATE CONTROL



★ The finer grain produced by TRAUWOOD electric resistance heating develops the maximum physical and fatigue properties in any steel in either patenting, tempering or annealing. The annealing of stainless steel and other alloy wire and strip is readily accomplished since the high quenching temperatures necessary are easily and rapidly attained.

CAN BE DESIGNED FOR ALL SIZES AND TONNAGES



★ The TRAUWOOD process, in addition to doing a better wire heat treating job, is opening new fields of application for the wire industry. The equipment is designed to meet your specific requirements and can be built to handle all sizes in any tonnage required. Full information will be furnished on request.

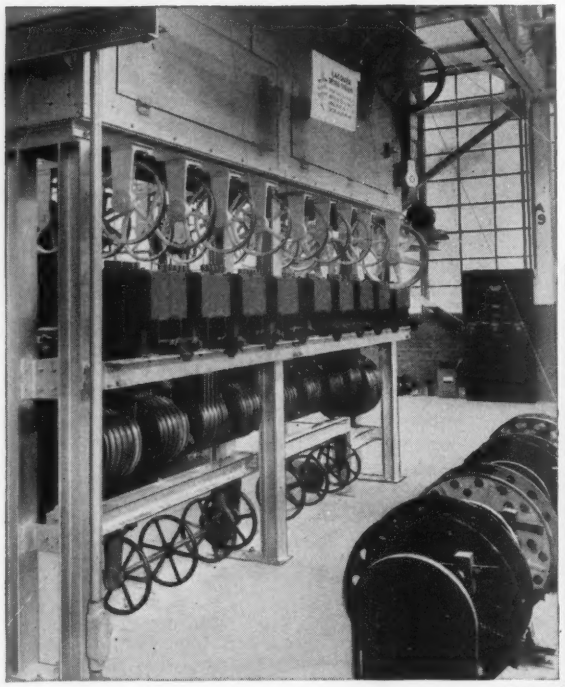
Patented in U.S.A. and Foreign Countries

THE TRAUWOOD ENGINEERING COMPANY

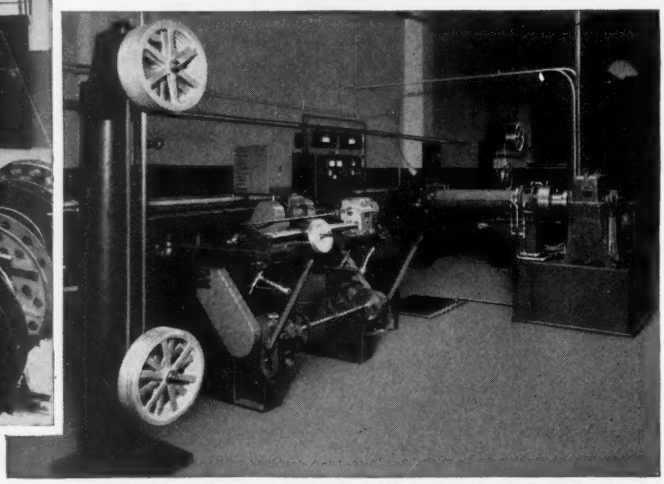
15200 BROOKPARK ROAD • BOX 2719 WESTPARK STATION • CLEVELAND, OHIO

JOHN RIGBY & SONS, LTD., LOW MOOR, BRADFORD - YORKS. ENGLAND — BRITISH REPRESENTATIVE
LABORATOIRE ELECTRONIC CENTRAL, 12 RUE SIMONON, LIEGE, BELGIUM—BELGIAN REPRESENTATIVE

WHETHER YOU COAT WITH *Solutions* OR *Solids*



You'll do it better, faster, at *lower cost* with an IOI coater of advanced design



ORGANOSOL COATER

The organosol system shown above will handle 9 ends of wire, each end being coated with as many as 8 individual coats. It is the thirty-second such system installed by IOI. Photograph shows the general arrangement of the coating pots, the wire travel, the bottom idler sheaves and the base of the evaporating tower.

EXTRUSION SYSTEM

Photograph (right) shows the takeup end of a complete extrusion line with nylon head tuber. Tension control stand and dual reel continuous takeup machine are shown in the left foreground. Driven letoff stand and tension stand are shown in background beyond the tuber.

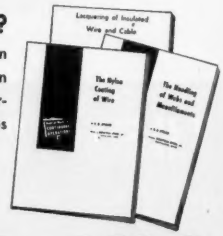
ARE YOU looking for ways and means of cutting production costs in your wire insulating operations? The largest wire mills in the world have found the answer to this problem by installing wire insulating systems and machines designed and built by IOI.

Whether your operations involve the extrusion of plastic tubing or strand, or the plastic jacketing of wire, cord or cable, or solution coating with lacquer, enamels, organosols or plastisols, there's an IOI unit of advanced design that will increase your production, cut your labor requirements and decrease your production costs.

The lacquering unit and extrusion system pictured are typical of IOI's developments in advanced engineering on sound basic principles, efficient design and rugged construction.

Do you want to cut production costs?

IOI's advanced engineering on sound basic principles can help you if you will outline for us your specific production problem. Write for these valuable IOI booklets: "Lacquering of Insulated Wire and Cable", "The Handling of Webs and Monofilaments", "The Nylon Coating of Wire."



INDUSTRIAL OVENS, INC.

IOI ENGINEERING VERSATILITY

13825 TRISKETT ROAD CLEVELAND 11, OHIO

MOSSBERG PRESSED STEEL CORP.

designed

NO-CREV SPOOLS

and **REELS** with

patented **DURA-CURL** rims

providing the ultimate

in strength and durability

P

L

U

S

precision and balance for

high-speed operation.

GREETINGS 1950

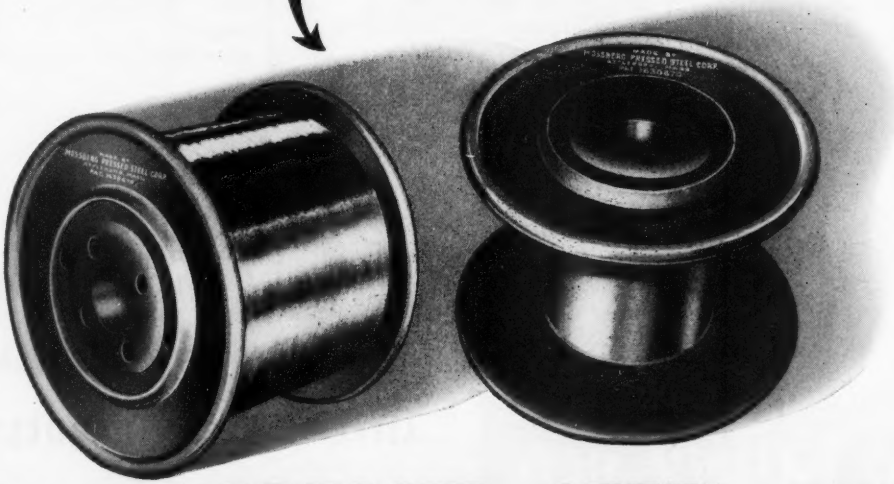
FROM THE LARGEST

HEAVY DUTY **BREAK-DOWN-REELS**

TO THE FINEST WIRE —

NO-CREV DESIGN **SPOOLS**

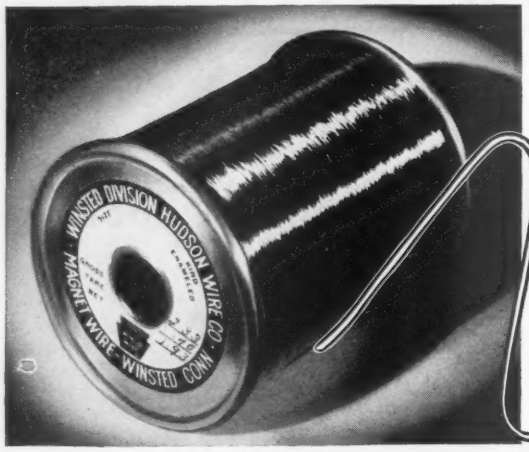
These developed refinements mean *trouble-free-winding.*



MOSSBERG PRESSED STEEL CORP.

18 WEST STREET ATTLEBORO, MASSACHUSETTS, U.S.A. Telephone Attleboro 1-0847 & 1-0848

James Day (Machinery), Ltd., 90 Regent Street, London, W. I. England



FINE Wire

CUSTOM-DRAWN AND INSULATED

FINE WIRES
(HUDSON & WINSTED DIVISIONS)

Hudson Wire Company specializes in fine wires custom-drawn and insulated to your critical requirements as to size, material, insulation. Your consideration is called particularly to the finest wire sizes —Nos. 44 to 50 or .0020 to .0010 nominal bare, and .00225 to .0012 nominal enamel.

BARE WIRES
(HUDSON WIRE DIVISION)

- Copper
- Brass
- Zinc
- Tinsel
- Tin
- Nickel-silver
- Cadmium
- Oxygen-free Copper
- Silver-plated Bronze
- Phosphor-bronze
- Silver
- Monel
- Specialty Wires
- Lead Wire

Fuse Wire

ENAMELED WIRES
(WINSTED DIVISION)

MATERIALS	TYPES	COVERINGS
Copper	Instrument Tubing	Plain and Heavy Enamel
Aluminum	Litz	Formvar
Resistance Alloy	Twisted	EZsol (Liquid Nylon)
Iron		Cement-coated Enamel
Copper-clad Steel		

TEXTILE-COVERED WIRES
(WINSTED DIVISION)

- Nylon
- Celanese
- Silk
- Cotton
- Rayon
- Fiberglas

All available on bare or enameled wire, single or double covered.

• LET US WORK WITH YOU
IN MEETING YOUR REQUIREMENTS
LITERATURE ON REQUEST

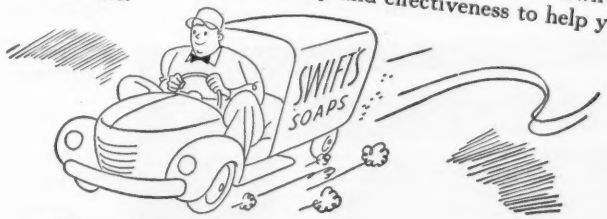
HUDSON WIRE COMPANY

BARE WIRES **GENERAL OFFICES: OSSINING, N.Y. • WINSTED DIVISION: WINSTED, CONN.** INSULATED WIRES

Rely on your SWIFT'S SOAP TEAM!

We're READY with quality soaps for every wire drawing need! You can always find the right soap for the job in Swift's complete line. Whatever your specialized need, Swift's Soap Department can fill it. And you'll find that Swift's Soaps for wire drawing uses have efficient lubrication, minimum dusting and dependable uniform quality. You can't buy finer soaps anywhere.

WILLING to continue Swift's research laboratory activities to develop better products for your purpose! Our technical division is constantly working on wire drawing problems. This means that Swift Soap products always have the quality and effectiveness to help you get better results.



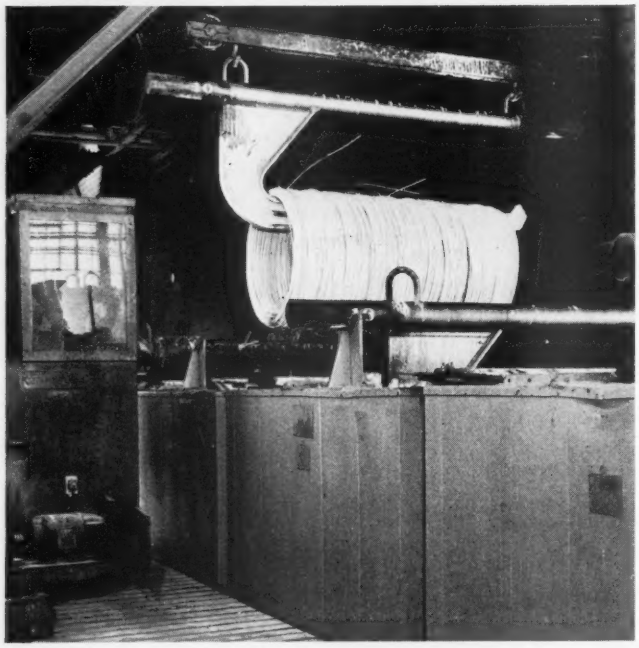
And ABLE to give fast service from Swift distribution points coast to coast! You can order any of the fine soaps listed below and expect immediate delivery. Remember—use good soap and enough of it! Good soap promotes economy for you . . . better products for your customers. *Powdered White Ribbon • Guaranteed Powder Snap Heavy Duty Wire Drawing Powder No. 282 No. 559 Powdered Soap*

Plus other special formulations to meet your specifications.

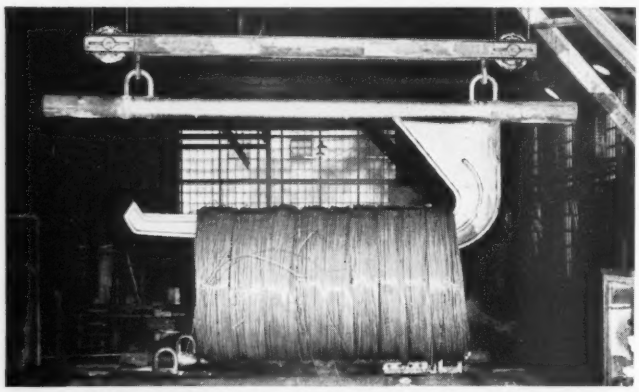
See your local Telephone Directory for address of your nearest Swift & Company office.

Call SWIFT first for soaps

For Top-Most Value in Wire and Wire Rope Today it's *Roebling*..



Weldco hook and wire, coming from the lime tank, are about to enter the baker.



A Weldco hook, carrying coiled wire, is shown emerging from hot sulphuric acid.

And WELDCO Hairpin Pickling Hooks *Help Maintain this Roebling Quality Leadership*

The John A. Roebling's Sons Company has one of the largest specialty wire mills in America. From steel-making to finished wire—throughout every operation—quality is assured by Roebling techniques and modern manufacturing facilities. In the handling of coiled wire, for instance, Roebling uses 18 Weldco pickling hooks, and each one carries 60 tons of wire per day!

Weldco hairpin pickling hooks combine light weight, toughness and high strength. Made of long-lasting, corrosion-resistant Monel, they handle payloads up to 4200 pounds, withstand sulphuric acid solutions, and outlast bulky cast hooks 2 to 3 times. These easy-to-handle hooks have outstanding service records, and offer, also, many other cost-cutting, time-saving features:

SUPERIOR DESIGN

Readily adaptable to all types of handling equipment.

Fast, easy loading and unloading of coils.

"Single-point contact" between hook and coil, provides more thorough pickling and cleaning.

Jacketed Monel spreader keeps rusty moisture from falling onto the coil . . reduces damage and rejects at the draw bench.

ECONOMICAL, EFFICIENT OPERATION

Big savings in the low, initial cost.

Long production life—years and years of heavy-duty service.

Bigger payloads—fewer "trips"—less cost per ton.

Less maintenance—fewer replacements because of the excellent resistance of rolled Monel to sulphuric acid and fumes.

No breakage, because of Weldco's unusual strength.

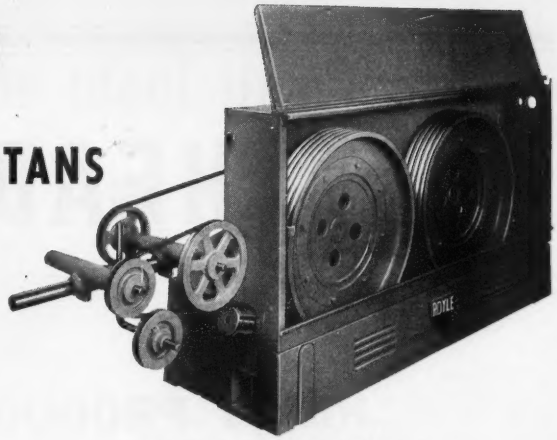
Leading wire mills throughout the country have discovered that Weldco lightweight hooks reduce pickling costs and improve production methods. Our Engineering Department will be glad to give you further information . . . and offers complete engineering service on your entire pickling line.

THE YOUNGSTOWN WELDING & ENGINEERING COMPANY

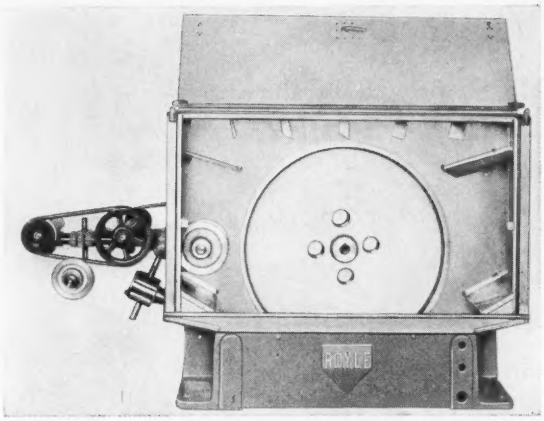
3706 OAKWOOD AVENUE . . YOUNGSTOWN 9, OHIO

ROYLE { LIGHT WIRE and CABLE CAPSTANS

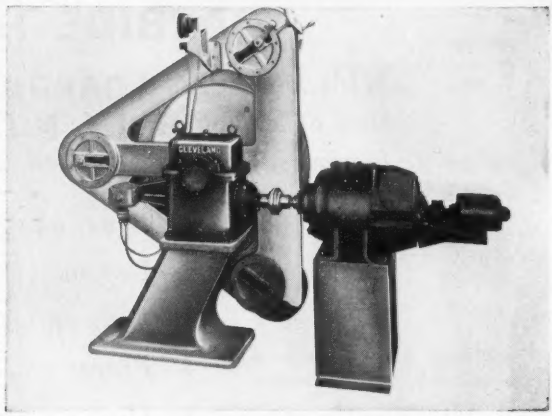
- ★ Continuous Vulcanizing Machines for Rubber Wire Insulation
- ★ Plastic Wire Insulation Machines
- ★ Strainers
- ★ Cooling Troughs
- ★ Motorized Take-Ups
- ★ Temperature Control Units



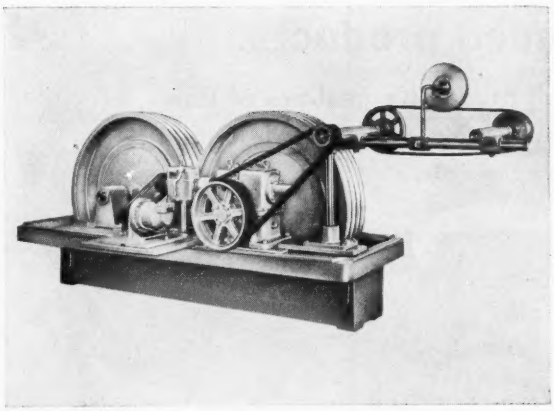
36" Heavy Duty Dual Capstan



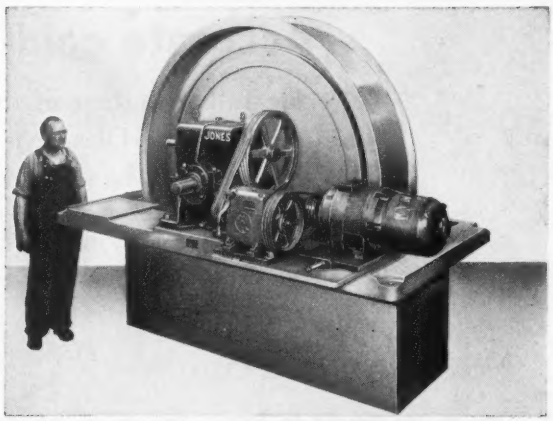
36" High-Speed Capstan



Special 36" Western Electric Capstan.
Floor mounted with separate motor drive.



60" Dual Capstan. Also available in 84".



84" Single Capstan. Also available in 60".

JOHN ROYLE & SONS

ROYLE PATERSON N. J. 1880

PIONEERED THE CONTINUOUS EXTRUSION PROCESS IN

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COLD HEADING DIES

. . . that can take it!

HEAVY PRODUCTION SCHEDULES call for the use of CARBIDE HEADING DIES

With EASTERN'S **CARBIDE DIES,** proven in the experience of leading **BOLT, NUT, RIVET** and **SCREW** manufacturers, you can be assured of . . .

1. *Lower unit die cost,*
2. *Dependable service,*
3. *Long uninterrupted runs,*
4. *Proper grades of carbide,*
5. *High quality workmanship, and*
6. *Superior finish, resulting in—*

Accurate cold-headed products.

To secure full advantage of the high productive qualities of Carbide Cold Heading Dies, it is recommended that Carbide Quills and Cut-Off Knives be used wherever possible.

We carry a complete line of carbide tooling for the cold-heading industry. *Your inquiries are solicited.*

Please write or 'phone:

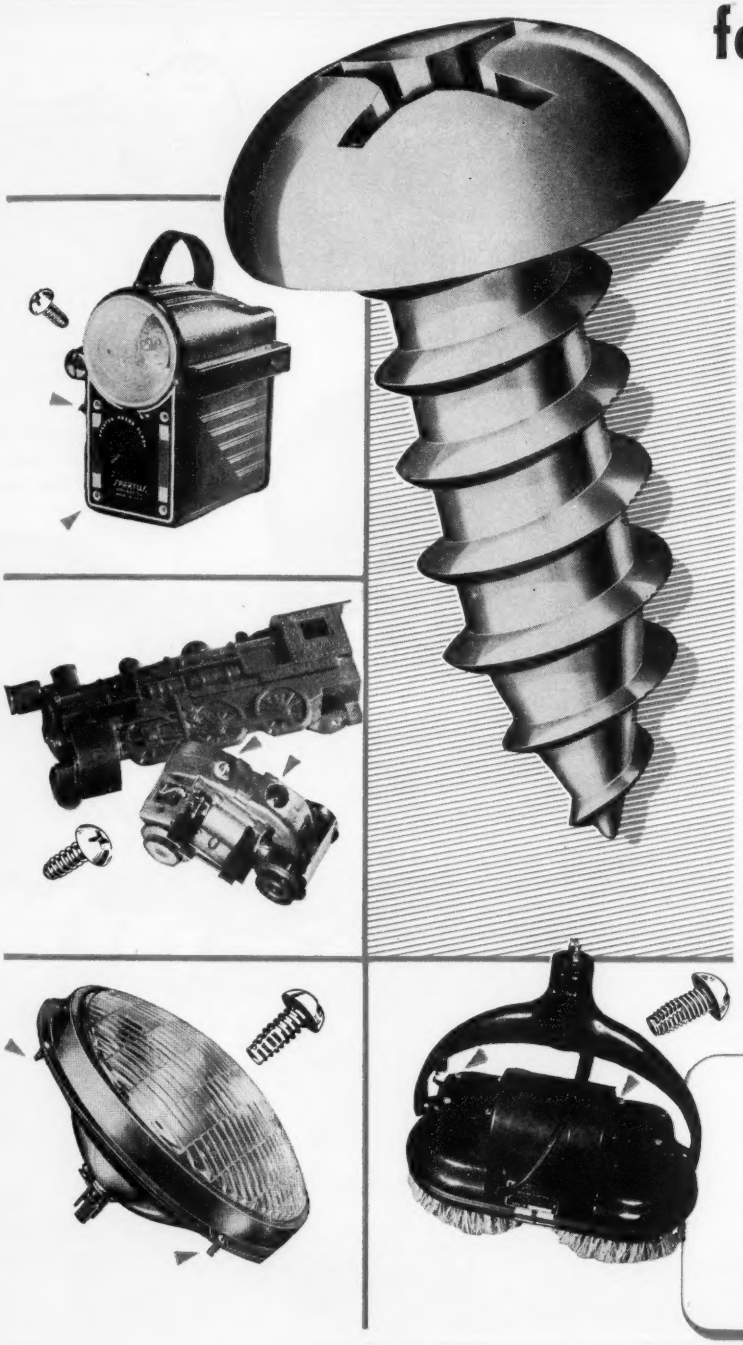
EASTERN CARBIDE CORPORATION

Telephone: New Rochelle 2-6630

909 Main Street — New Rochelle, N. Y.

Complete Carbide Sales and Service

Amerhead, the *ideal* Heading Wire for the most exact upset parts



THE self-tapping screw market is on the upswing, for this product has enabled many manufacturers to *drastically* cut high assembly costs.

But self-tapping screws must be made with great care, if they are to do the best possible job. Inspections are rigid. The most modern production methods are utilized. The very finest wire *must* be used.

That's why so many fastening designers insist on Amerhead Heading Wire. Precision quality control keeps Amerhead Heading Wire remarkably free from physical defects. You can be sure of the exact strength, hardness and workability that you specify.

But even more important: Precision quality control is your true assurance of *uniformity*. As a result, when you reorder—in a month, or in a year—you'll get the *same* wire, with the *same* properties that you got in *every* previous order.

If that kind of uniformity means a lot to your operation, write for more information today.

If you use Heading Wire . . . use

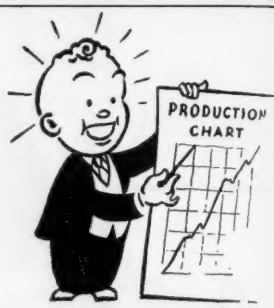
AMERHEAD

AMERICAN STEEL & WIRE COMPANY, GENERAL OFFICES: CLEVELAND, OHIO
COLUMBIA STEEL COMPANY, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS
TENNESSEE COAL, IRON & RAILROAD COMPANY, BIRMINGHAM, SOUTHERN DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS

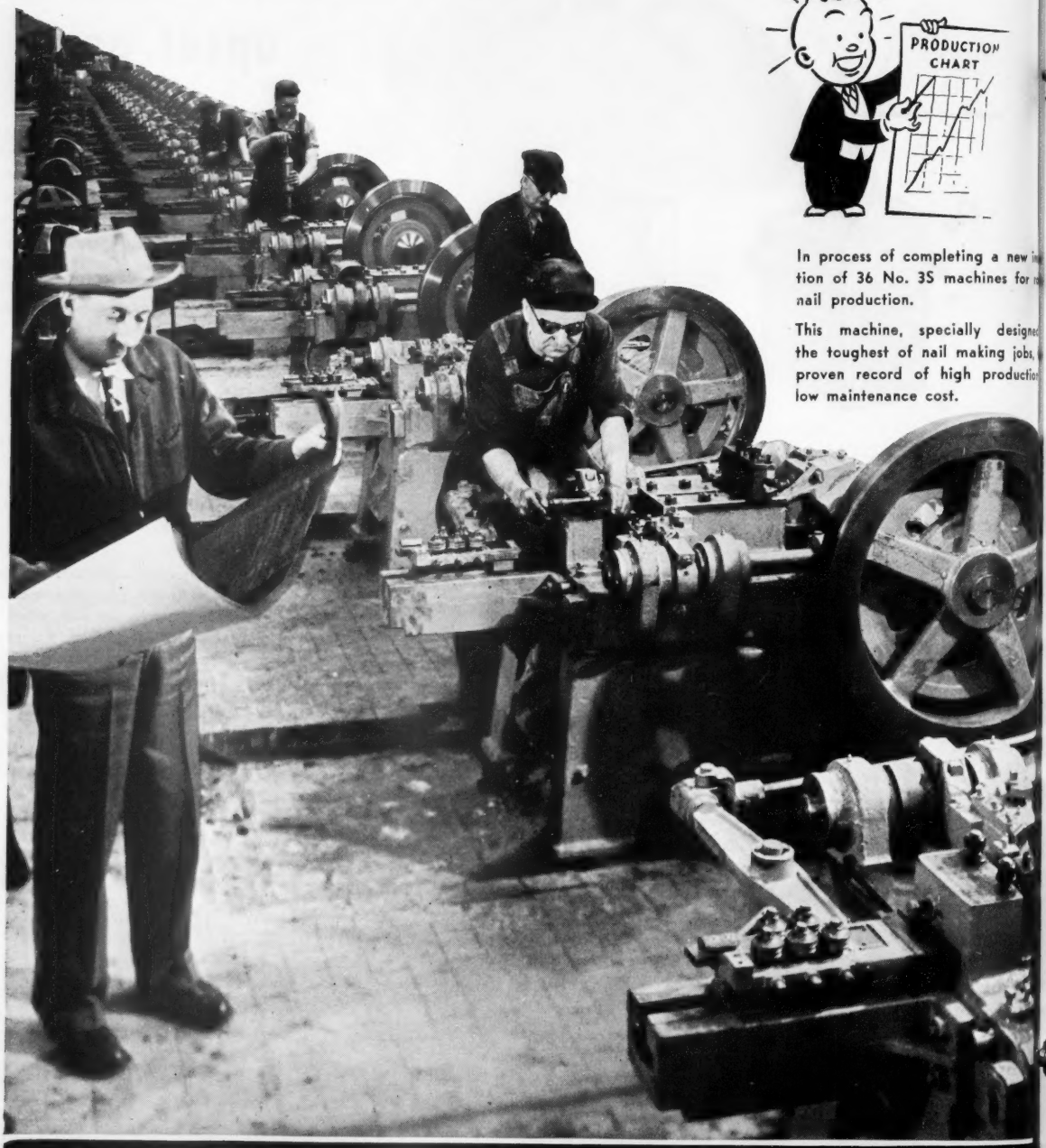
UNITED STATES STEEL

GLADER WIRE M



In process of completing a new in
tion of 36 No. 3S machines for r
nail production.

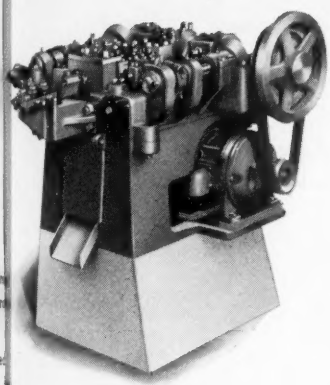
This machine, specially designe
the toughest of nail making jobs,
proven record of high productio
low maintenance cost.



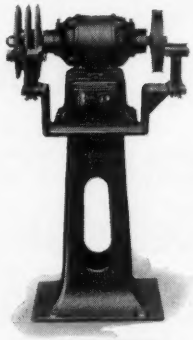
Wm GLADER MACHINE WORKS

210 N. RACINE AVENUE
CHICAGO 7, ILLINOIS, U. S. A.

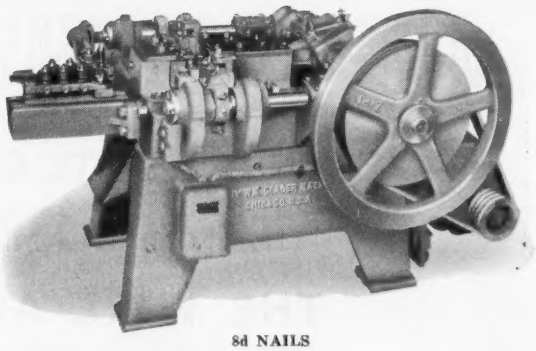
NAIL MACHINERY



BRADS



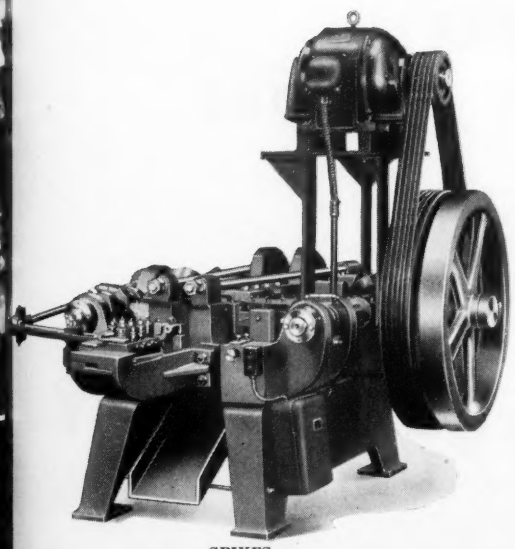
DIE GRINDER



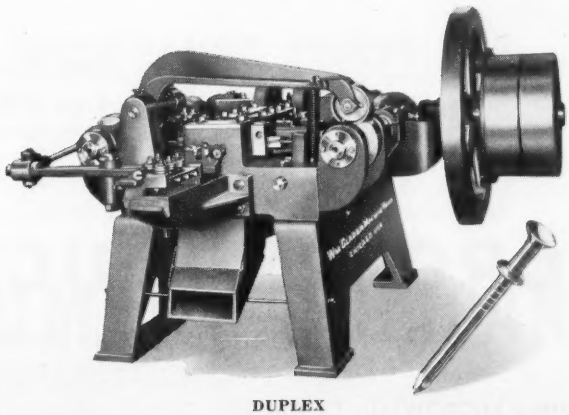
8d NAILS

For more than fifty years GLADER Nail machines have been the outstanding machines for wire nails.

Rugged construction, simplicity of adjustment, low maintenance cost and high efficiency of these machines have resulted in their being the No. 1 choice of nail makers throughout the world.



SPIKES



DUPLEX

MICROMETER PRECISION
MICRO-WELD
TRADE MARK REGISTERED

MICRO PRODUCTS COMPANY

EXTENDS HEARTY GREETINGS TO ALL

MEMBERS AND GUESTS OF

THE WIRE ASSOCIATION

MICRO-WELD BUTT WELDERS ARE MANUFACTURED IN DIFFERENT MODELS TO BUTT WELD HIGH AND LOW CARBON STEEL AND STEEL ALLOYS IN SIZES FROM .004" TO 1¼" DIAMETER, AND NON-FERROUS WIRE AND RODS RANGING IN SIZE FROM .004" TO ⅞" DIAMETER

A WELDER FOR EVERY PURPOSE

DISCUSS YOUR WIRE WELDING PROBLEMS WITH OUR MR. G. L. MAY, WHO WILL BE IN ATTENDANCE DURING THE CONVENTION

MICRO PRODUCTS COMPANY

20 NORTH WACKER DRIVE, CHICAGO 6, ILL.

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Telephone STATE 2-7468

Buy at Tinsel Headquarters

BARE TINSEL CONDUCTORS

Designed to give extreme flexibility and long life in:

(1) Telephone Receiver Cords
(2) Telephone Switchboard Cords
(3) Head Set Cords for Radio-Television, etc.
(4) Electric Razor Cords
(5) Hearing Aid Cords
(6) Radio Loudspeaker Voice Coil Leads
(7) Lead in Wires for Electrically Heated Blankets, Clothing, etc.
(8) To meet National Electric Code Standard for Flexible Tinsel Cords.

All wound on reels ready for insulating with plastics, rubber, etc.

TINSEL LAME

Made of flat copper wire. Supplied Silver Plated and False-Gold Coated. Furnished in assorted sizes, wound in large packages for economical weaving of Tinsel Ribbons on high speed machines.

DECORATIVE TINSEL THREADS

Packaged for weaving, knitting, etc., of Dress, Slipper and Millinery Fabrics, Braids and Trimmings.

BARE ELECTRICAL CONDUCTOR and RESISTANCE ELEMENTS for

Special uses where constant flexing and long life is desired.

BARE RESISTANCE TINSEL for

Electrically Heated Blankets, Clothing and so forth.

Write for samples and technical data, or send description of your special requirements.

THE MONTGOMERY COMPANY

WINDSOR LOCKS
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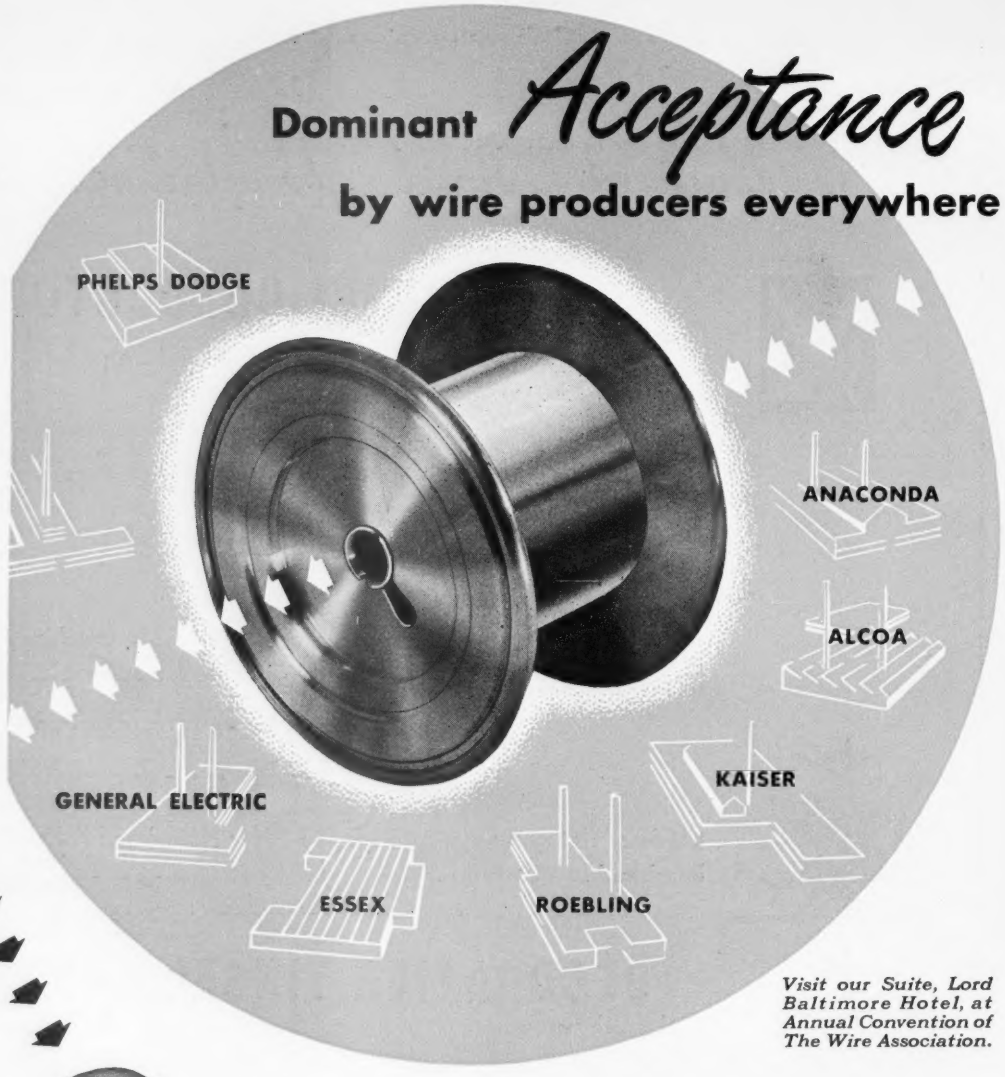
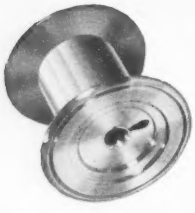
Est. 1871 Tel.: 14

ACROPAK

Dominant *Acceptance* by wire producers everywhere



Visit our Suite, Lord Baltimore Hotel, at Annual Convention of The Wire Association.



Stands the gaff because

- ***EXTRA STRENGTH***
- ***LIGHT WEIGHT***
- ***PRECISION BUILT***

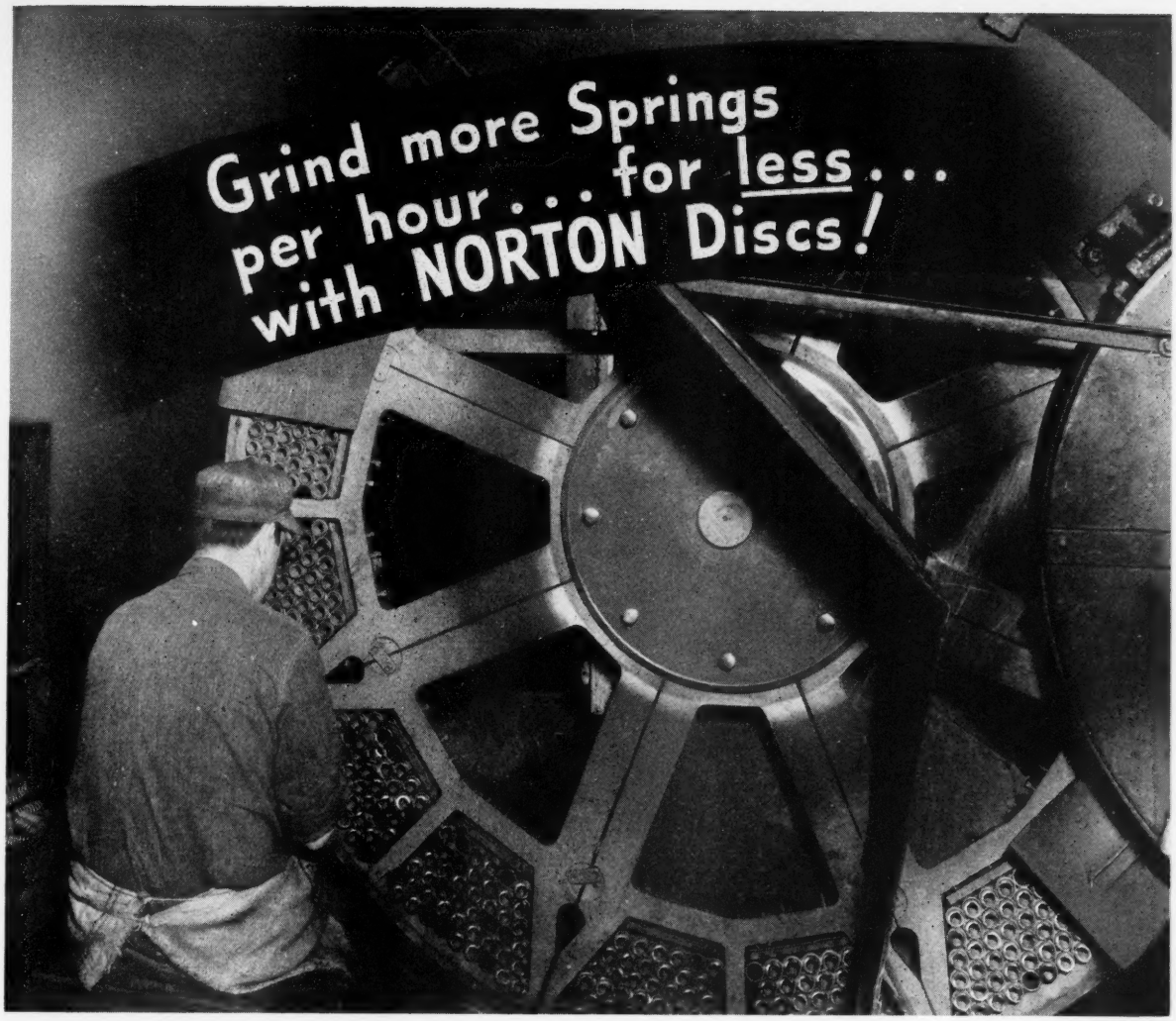
Low Maintenance Cost Less Reconditioning . . .

It is no accident that ACROPAK drawn aluminum spools have gained dominant acceptance. They are stronger, lighter, well-balanced and true running. They stand the gaff—with less toe-out and fewer snags. The best known names in the wire industry have adopted ACROPAK 4½″, 6″ and 8″ spools as standard.

ACROPAKS last longer—require less maintenance. When reconditioning is needed, it can be done faster, easier and at less cost with special fixtures we supply. Light weight ACROPAK shipping spools reduce freight costs—repay original investment. ACROPAK drawing spools speed up production and reduce spooling costs.

ACROMETAL PRODUCTS INC. • MINNEAPOLIS, MINN., U. S. A.
Division of U S Bobbin & Shuttle Co.

PRECISION SPOOLS FOR THE WIRE INDUSTRY



YOU can increase spring production and reduce spring grinding costs with Norton vitrified discs because they:

- **Cut Fast and Cool** — they contain 57 ALUNDUM abrasive or the latest Norton abrasive, 32 ALUNDUM — abrasives hard enough and sharp enough to easily penetrate the toughest alloy steels.
- **Have Extra Long Life** — the faster cutting action and more durable bond of Norton vitrified discs means less dressing is necessary — these discs last longer.
- **Have Uniform Grinding Action** — the same fast, cool cutting action from each disc throughout its entire life — discs not affected by coolant, aging or storage conditions.

Norton vitrified discs are available in all standard sizes (15" to 72" in diameter) and with all types of mountings.

NORTON COMPANY • WORCESTER 6, MASS.

Distributors In All Principal Cities

NORTON ABRASIVES

Making better products to make other products better

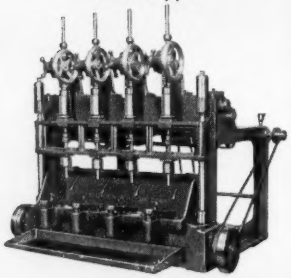
W-1323

IS YOUR DIE ROOM READY FOR THE TOUGH JOB AHEAD?

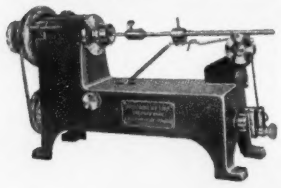
specify UNION

Die Room Equipment for Faster . . . Better Die Recutting

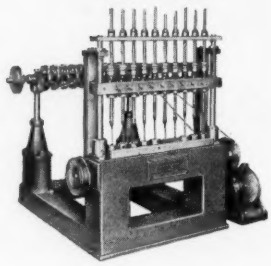
MODEL NO. 320
4-Head Ripper



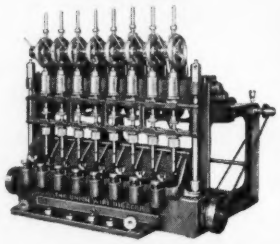
MODEL NO. 150
Single-Head Automatic Polisher



MODEL NO. 900
10-Spindle Polisher



MODEL NO. 800
8-Head Ripper



There will be a tremendous amount of wire drawn in the days facing us, and a tremendous number of dies to be serviced. Have you examined your die room lately to see if it is up to the job? Are you risking costly production stoppages just for the lack of adequate die cutting facilities?

We take pride in the fact that 94% of the die rooms in the United States have some UNION equipment . . . in many cases, all UNION. Yet, we have been steadily improving UNION machines through the years, based upon customer experience . . . sometimes minor changes, such as spindle reciprocation or die clamps, frequently a major change in design such as the pumping set-up on the rippers. At this time, when you should be seriously considering expanding die servicing capacity, you can still count on your old UNION machines but you may want to add some of the newest machinery to your present capacity. You may also find it wise to discard your out-dated non-UNION equipment which fails to incorporate automatic multiple-spindle principles that were first introduced into the field by UNION.

The machines pictured are only a few of those we manufacture. Every type has been thoroughly tested for economy, simplicity, and ruggedness, to insure low cost, accuracy, and low upkeep cost during many years of tough usage. For a detailed description of the entire line, for round-hole and shaped dies, for carbides and diamonds, write for our Bulletin M-1.

Don't let your die room become a bottleneck to full wire production. Check with UNION right now, and choose from the most complete line of equipment available anywhere for carbide and diamond die servicing. Then . . .

GET THE BEST — GET UNION!

Union Wire Die Corporation

Main Plant
375 FAIRFIELD AVE.
STAMFORD, CONN.

•

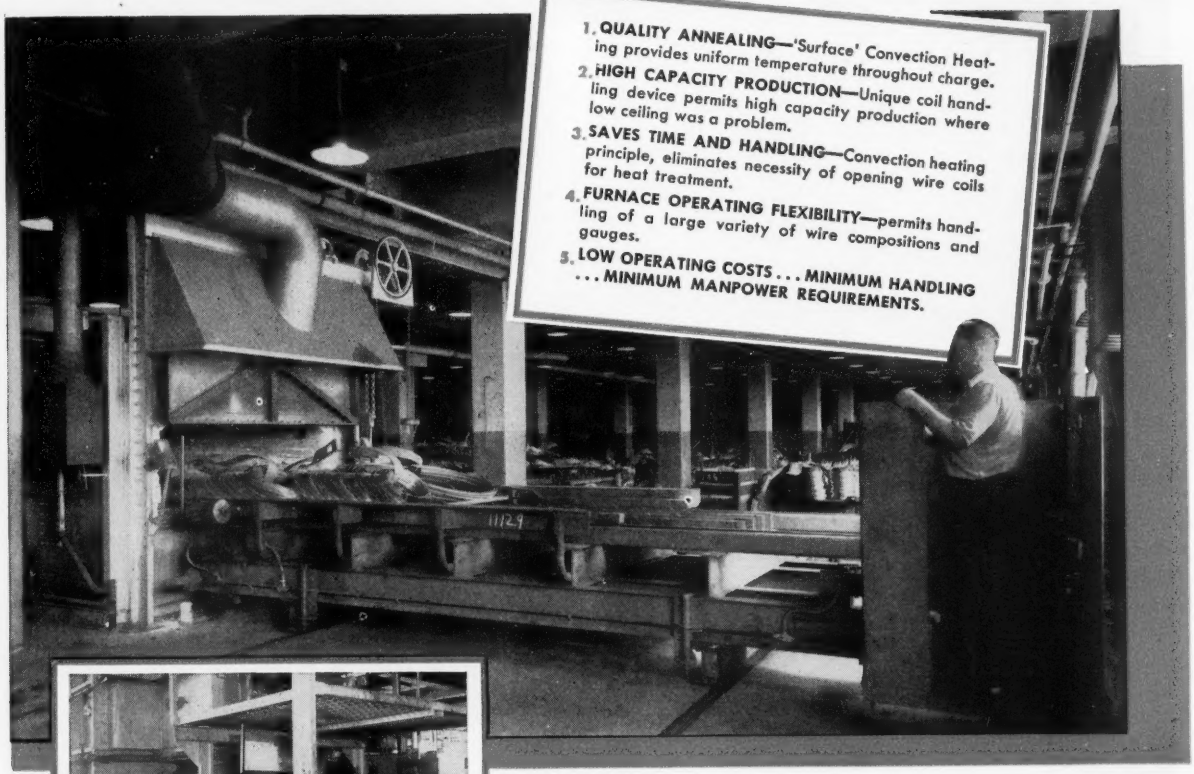
71 WEST 45th ST.
NEW YORK 19, N. Y.

•

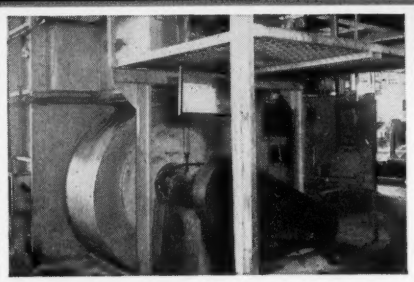
Affiliated with
LA FILIERE UNION
PARIS, FRANCE

'Surface' WIRE ANNEALING FURNACE

. . . meets unusual production requirements



1. **QUALITY ANNEALING**—'Surface' Convection Heating provides uniform temperature throughout charge.
2. **HIGH CAPACITY PRODUCTION**—Unique coil handling device permits high capacity production where low ceiling was a problem.
3. **SAVES TIME AND HANDLING**—Convection heating principle, eliminates necessity of opening wire coils for heat treatment.
4. **FURNACE OPERATING FLEXIBILITY**—permits handling of a large variety of wire compositions and gauges.
5. **LOW OPERATING COSTS . . . MINIMUM HANDLING . . . MINIMUM MANPOWER REQUIREMENTS.**



Rear view of 'Surface' Annealing Furnace showing high speed—high capacity recirculating fan used for convection heating. This assures maximum speed and uniformity of heating.

The many 'Surface' Heating Installations, whether convection heating, direct-fired or controlled atmosphere, have proved their economy in operation.

Quality heat treating, at a production rate to keep pace with high volume drawing operations, was made possible in this low-ceiling building with the use of the highly-efficient 'Surface' Convection Furnace shown above. This furnace is equipped with a unique materials handling mechanism. Non-ferrous wire coils are sling-loaded on to an alloy charging tray which is moved in and out of the furnace on roller rails.

Non-ferrous wire is heat treated at rates of 2500 lbs. net, and upwards per hour. Temperature range up to 1250°F.

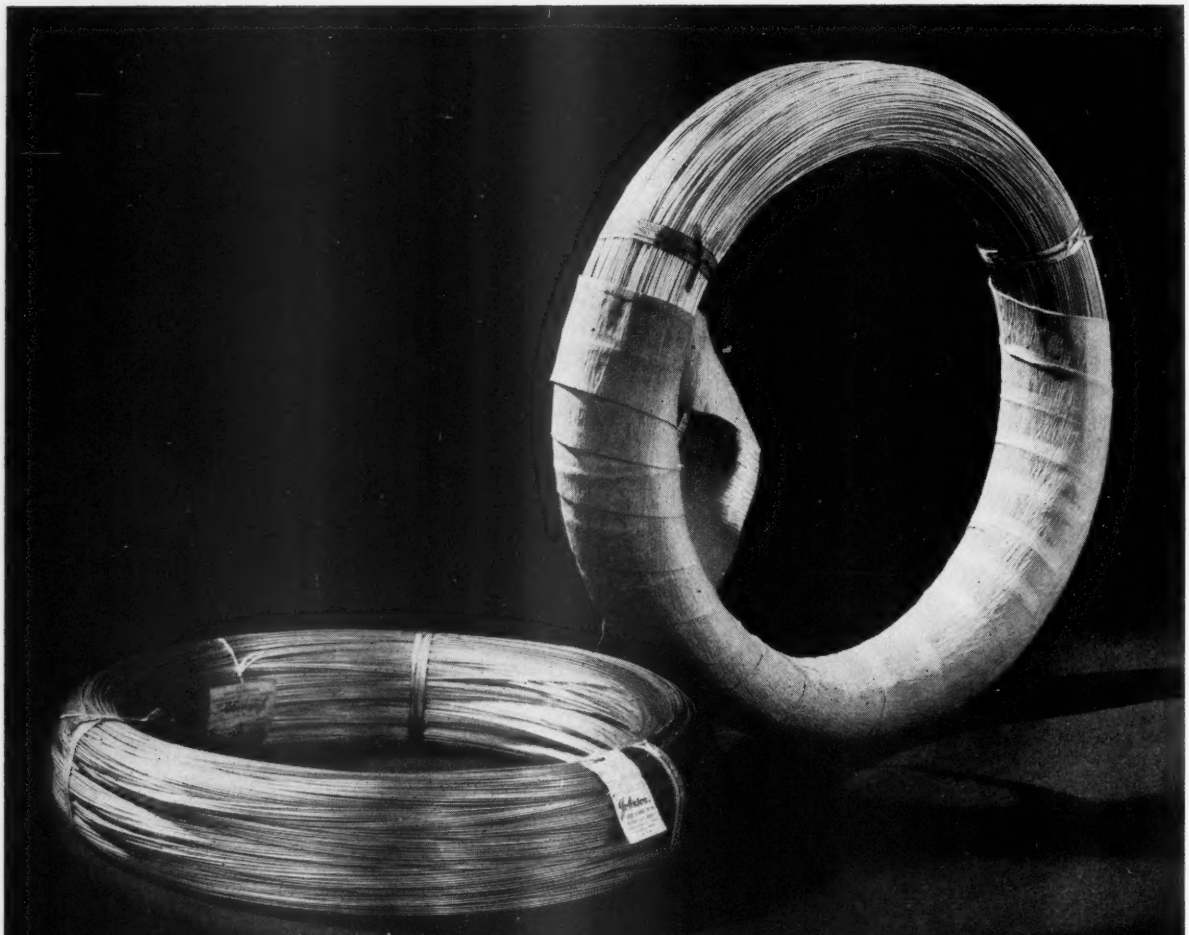
This is a typical example where 'Surface' personnel worked in cooperation with company management and engineers to design heat treating equipment in keeping with plant production needs. If you have a special heat treating problem for non-ferrous or ferrous materials, for any required temperatures, it will pay you to discuss it with a 'Surface' representative. No obligation.

SURFACE COMBUSTION CORPORATION • TOLEDO 1, OHIO

FOREIGN AFFILIATES: Stein & Roubaix, Paris — British Furnaces, Ltd., Chesterfield

'Surface' **INDUSTRIAL FURNACES**

FOR: Gas Carburizing and Carbon Restoration (Skin Recovery), Homogeneous Carburization, Clean and Bright Atmosphere Hardening, Bright Gas-Normalizing and Annealing, Dry (Gas) Cyaniding, Bright Super-Fast Gas Quenching, Atmosphere Malleableizing and Atmosphere Forging. Gas Atmosphere Generators.



JOHNSON is a wire specialty plant, not a tonnage mill. Every Johnson wire is drawn under close laboratory supervision, resulting in the specific wire for its intended use. Whether it be Music Wire—"The wire of a thousand uses"—or wire that is to be devoted to the enhancement of the lady beautiful (bobby pin wire, brassiere wire or corset stay wire), Johnson goes in for top quality and ease in processing. For example, Johnson Stainless Steel (18-8 grade, types 302 and 304) comes to you with lasting harmless lubrication (*not to be removed*).

Whatever your requirements in high tensile wire, let Johnson specialists go to work for you. You will find that the time saved in processing, less down-time, and the reliability of your production will be well worth while.

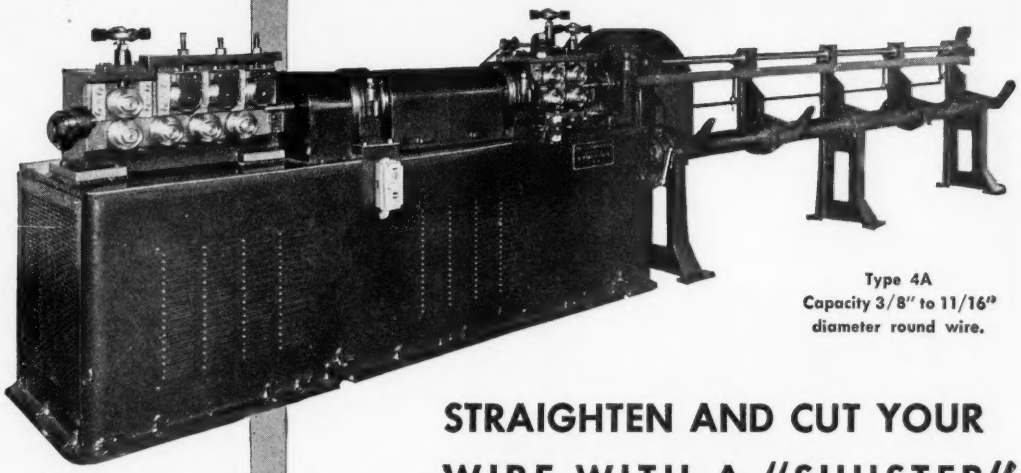
JOHNSON

STEEL AND WIRE COMPANY, INC.

WORCESTER 1, MASS.

New York Philadelphia Cleveland Detroit Akron Chicago Atlanta Houston Tulsa Los Angeles Toronto

"SHUSTER MACHINES are noted for their extremely fast feeds, greater cutting speeds that deliver undistorted, square-cut ends, and for construction that is extremely rigid and wear resisting."



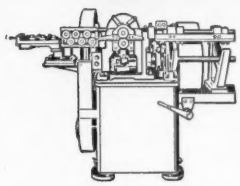
Type 4A
Capacity 3/8" to 11/16"
diameter round wire.

STRAIGHTEN AND CUT YOUR WIRE WITH A "SHUSTER"

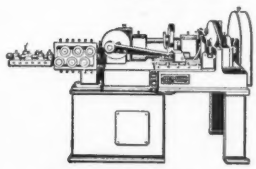
Round wire, flat, square or hexagon stock, tubing — all are straightened and cut faster, more accurately and more economically because of Shuster automatic features.

Each operation of the machine is perfectly integrated, delivering straight, exact lengths with square, clean-cut ends. Typical of this skillful engineering is the clutch and cut-off cam, which is instantaneous in operation. The cut-off lever is practically a flying shear, making the movement of the stock almost continuous. This minimizes swelling and marking of stock and produces uniform, undistorted ends.

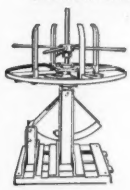
There is a SHUSTER for every wire straightening job from .025 to 11/16" diameter. Write today for our recommendation, describing your need. No obligation whatever.



FLAT STOCK STRAIGHTENERS



SLIDE FEED STRAIGHTENERS



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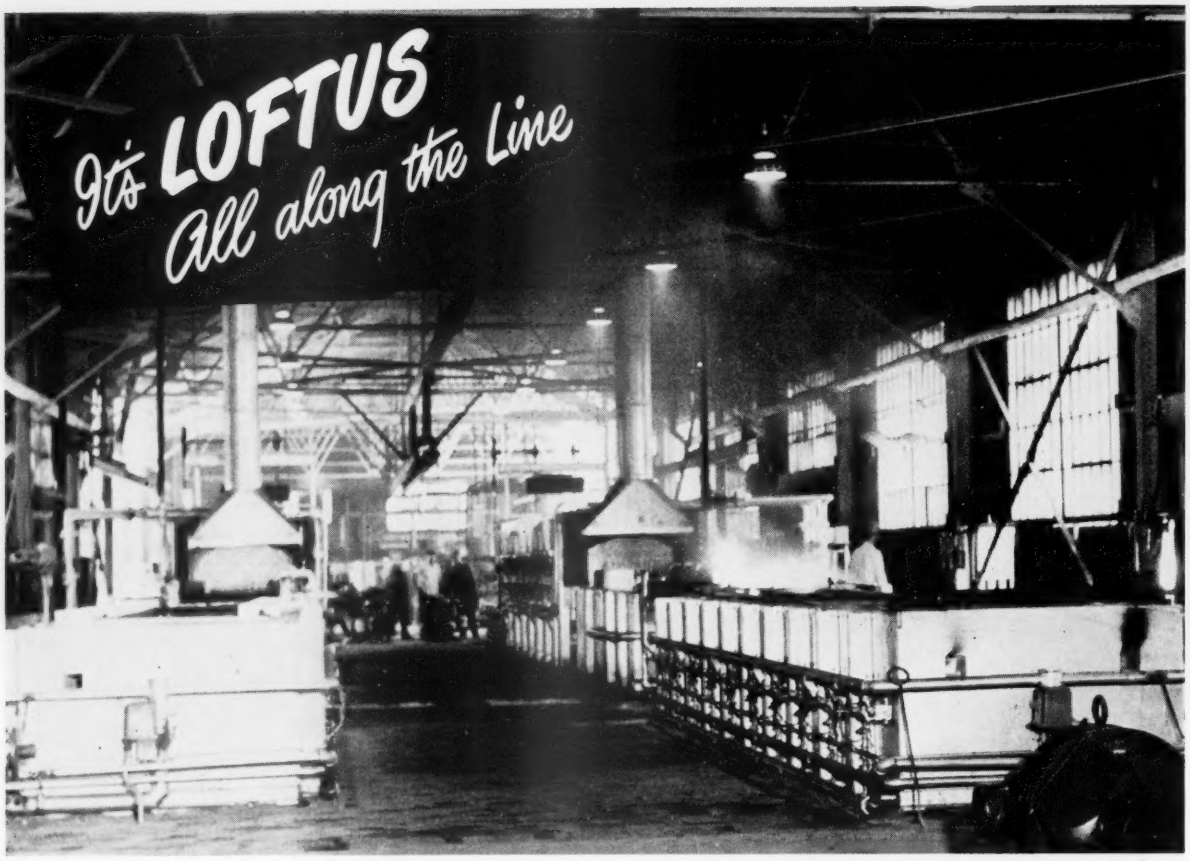

The Loftus Engineering Corporation offers this new development for continuous wire tempering. The equipment is now in successful operation in several locations and repeat orders from various plants have been received.

This improved equipment involves placing a lead wire preheat pot furnace ahead of the normal open gas fired furnaces. The advantages are a shorter total overall length of the furnace lines, reduction of oxidation, more uniform internal structure, less fuel and a definitely improved product.

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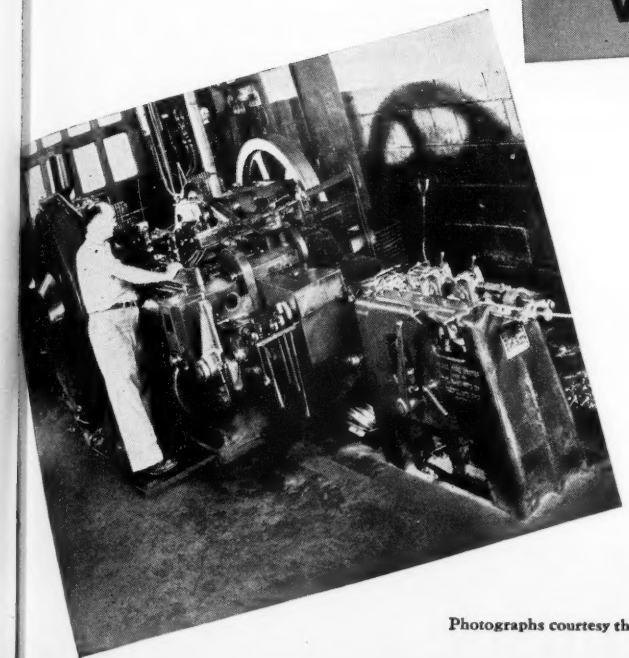

THE efficiency and quality of product of Cold Headers is materially stepped-up by the attachment of AJAX-HOGUE wire drawers. The wire, being freshly drawn to unvarying diameter as it is perfectly coated and fed to the header dies, heads easier, more uniformly and with much less wear on the header dies. This improvement in cold heading substantially lowers the cost of production in addition to the saving effected by the use of hot rolled rod instead of cold drawn wire.

Write for Bulletin No. 111.

Photographs courtesy the Chandler Products Corporation.

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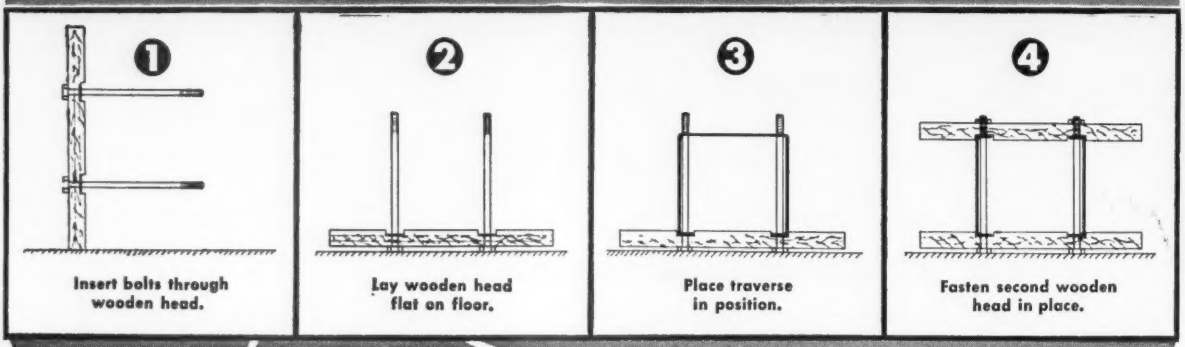

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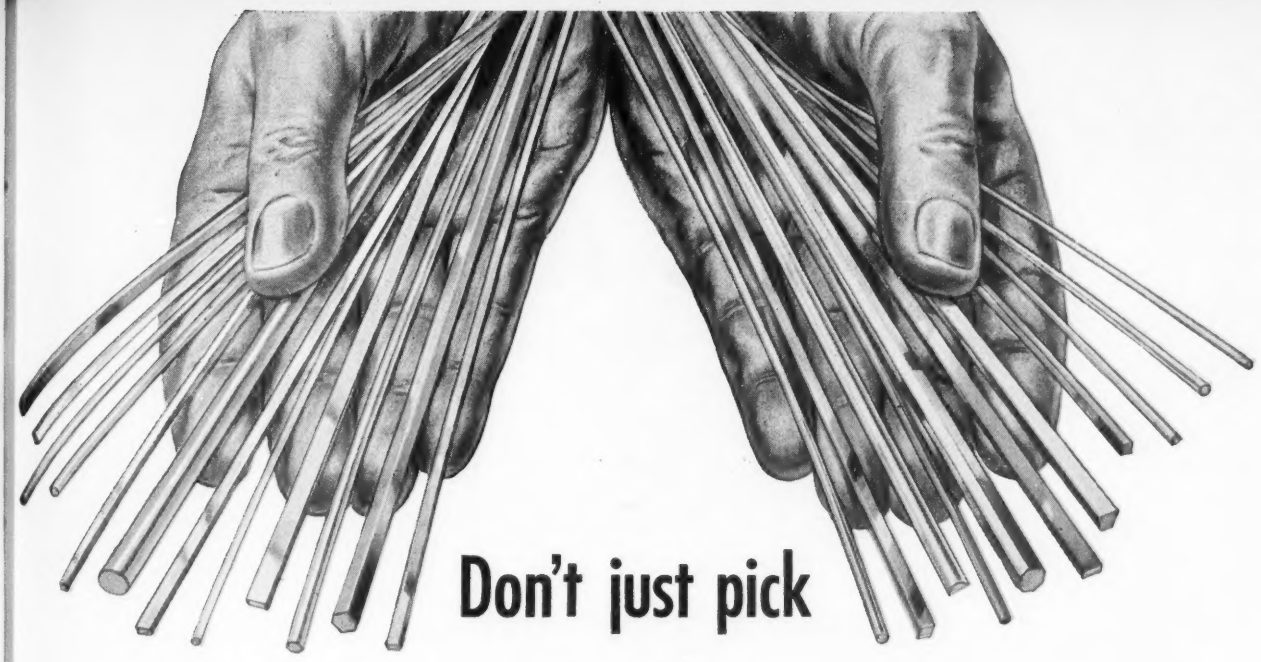

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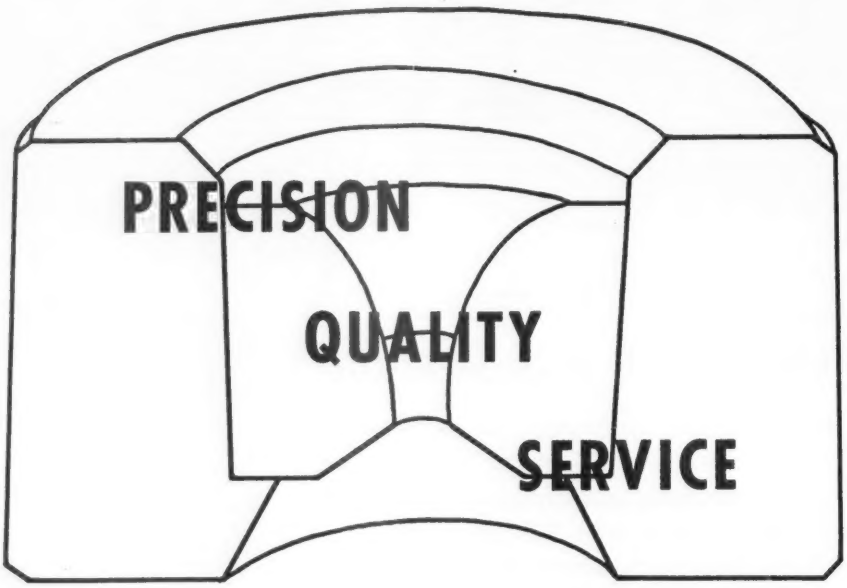

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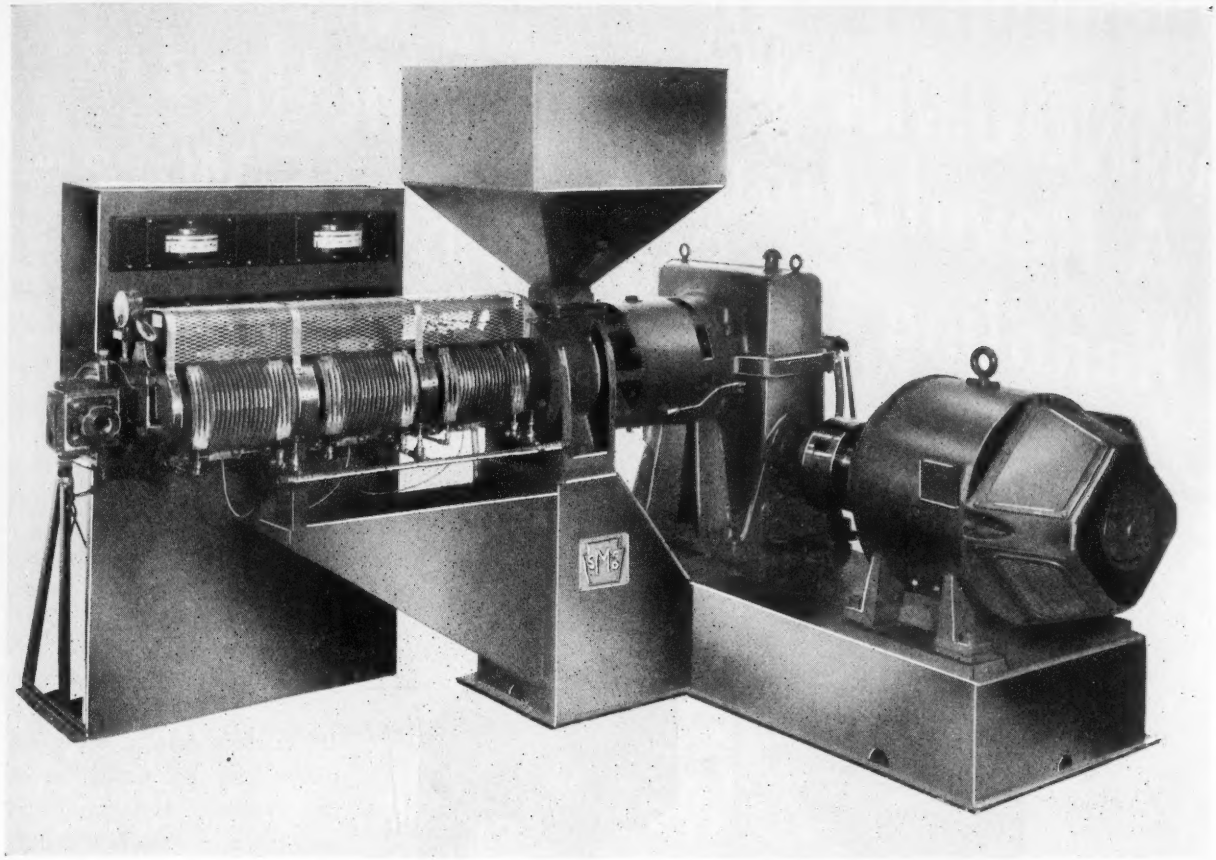

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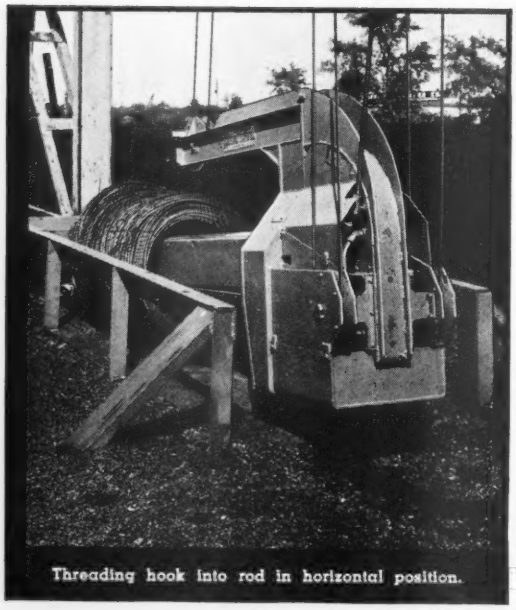
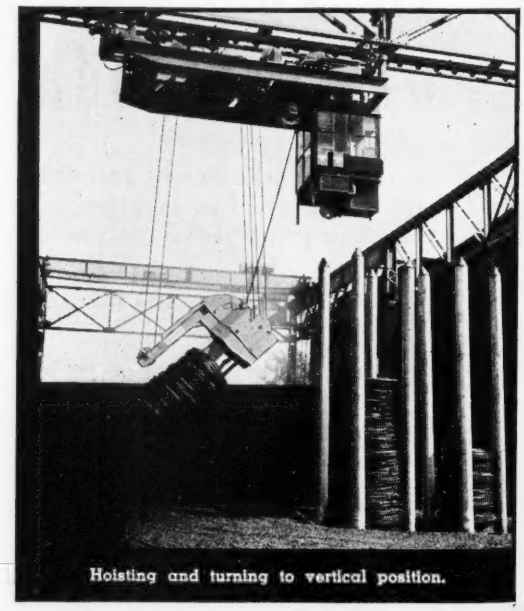


Threading hook into rod in horizontal position.



Hoisting and turning to vertical position.

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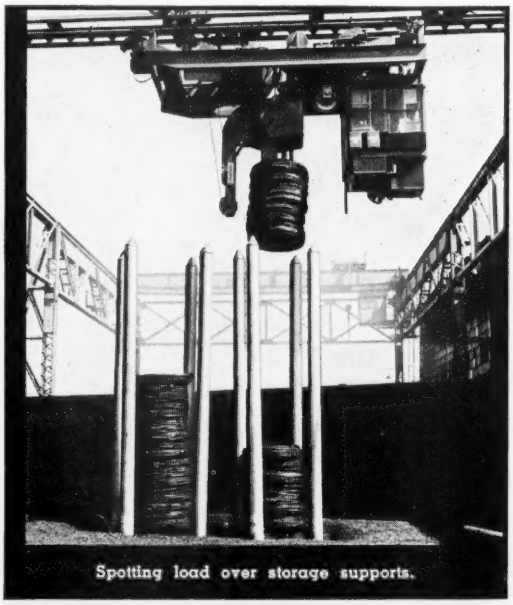
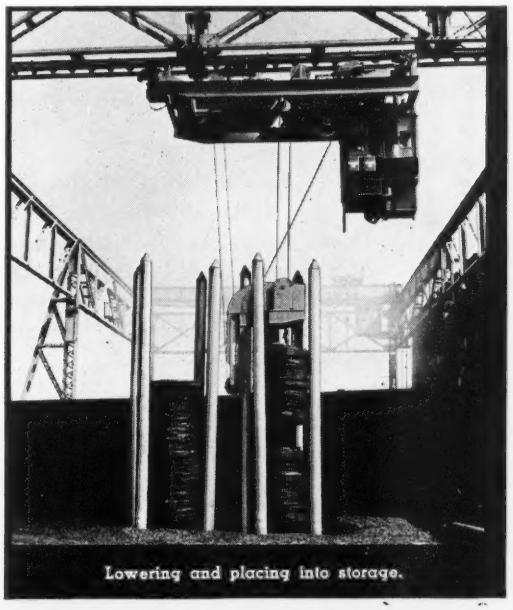
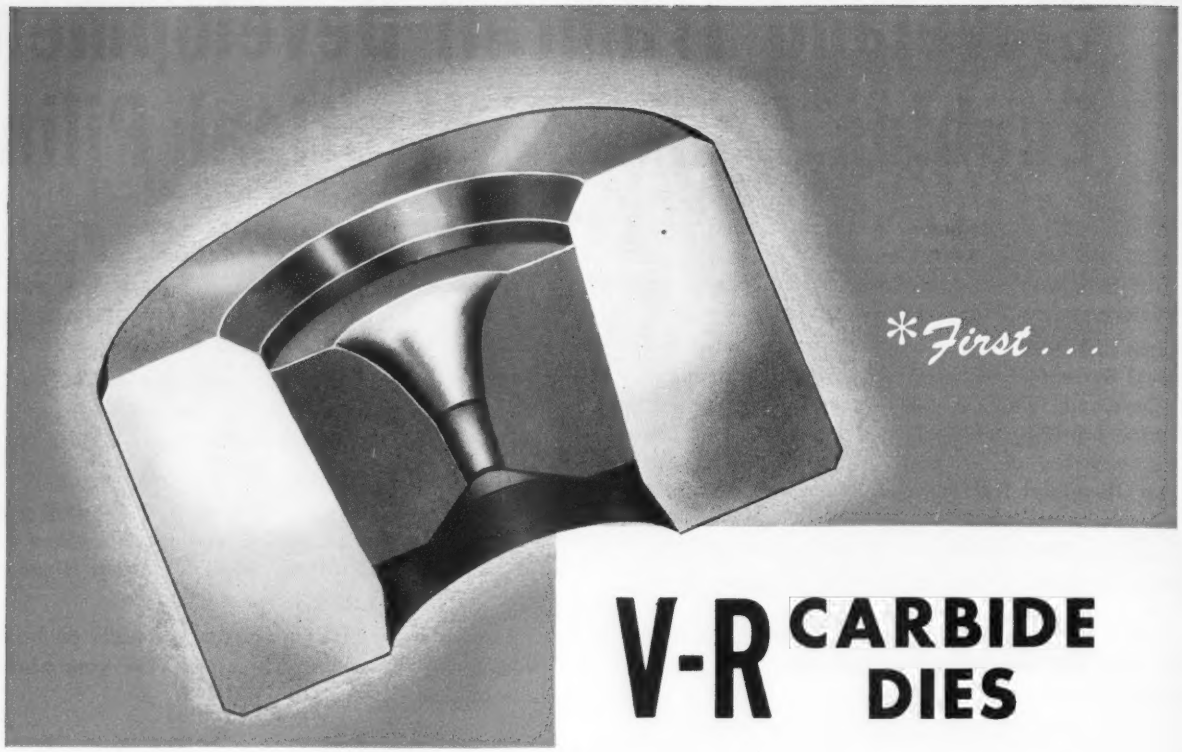


Spotting load over storage supports.



Lowering and placing into storage.



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The Wire Outlook

Wire men from all parts of the globe once again are about to assemble for their Annual Convention—this year in Baltimore. Not since the war years have we faced the prospect of such trying days ahead. For this Convention, on which the Korean affair casts its long shadow, a broad program has been provided that should be fruitful of much good for all conferees.

The publisher of WIRE AND WIRE PRODUCTS and his official family, together with the officers and directors of the WIRE ASSOCIATION, extend to those who are gathering in Baltimore a most cordial welcome. Besides the fine array of technical papers you are to hear and discuss, there will be some features on the lighter side through which a degree of relief from the daily grind of your heavy responsibilities at your respective plants may be secured. We shall be happy to see our friends again and look forward with you to a highly successful Convention.

★ ★ ★

Through the latter portion of the year we may expect record business levels, a scramble for higher wages, little unemployment, high prices, heavier taxes and an increase in the cost of living by the end of the year of about 4%. Taxes and upping prices, however, will consume more than the wage increases, leaving the public with less to spend on real or fancied needs.

The heavy buying in July and August will be offset by a decline in new orders, but overall volume of business will be high. While stockpiling and military orders have not yet affected civilian production materially, it is safe to assume that these will make themselves evident after the first of the year.

Circumstances are rapidly pushing the new cycle of inflation toward a conclusion. Many signs indicated that a bearish trend was in the making before we entered the Korean fracas; military spending has postponed for an indefinite period any corrective tendencies. This is bound to come later on, however, when we settle down to face a world at peace. Our costs of production are far out of line with those of the rest of the world and we will not be geared to compete with the lower costs from abroad. All industrial nations are producing goods at greater rates than ten years ago, with our own production facilities at record levels. Where shall we turn for markets in the future if our prices are too high and our own consuming power reduced by the heavy taxes with which we are saddled? The only offset to the tremendous cost of building up our military machine, as has been said many times before, would be for our Government to withdraw from the operation of business projects, to drop socialized welfare schemes and to cut down drastically on our spawning bureaus. The cost of government can and should be cut.

From a wire mill standpoint business is good. All the rods and wire, ferrous or non-ferrous, that can be made have takers. The demand for nails and practically all wire products is considerably greater than supply. Due to the need for allocating rods to provide equitable distribution, non-integrated mills are finding themselves again short. Some of them say their last quarter quotas have been lopped by as much as 50% of their requirements. To offset this, some wire product fabricators are making long-term commitments for foreign rods. It is going to be increasingly difficult for many mills to maintain proper inventories.

In the building field, the expansion in the construction of multiple dwelling housing projects has increased enormously the demand for low voltage and lightweight wiring. How the credit restrictions on the purchase of new residential construction will affect the demand for house wiring remains to be seen. Probably there will be some falling off in 1951 from this quarter.

Procurement is going to be the big problem for the period of the emergency. Doubtless many backlogs reflect duplicated orders and inflated demands, but there is no question that for many months to come there will be more orders on most books than products to fill them.

—from the Editor's Desk

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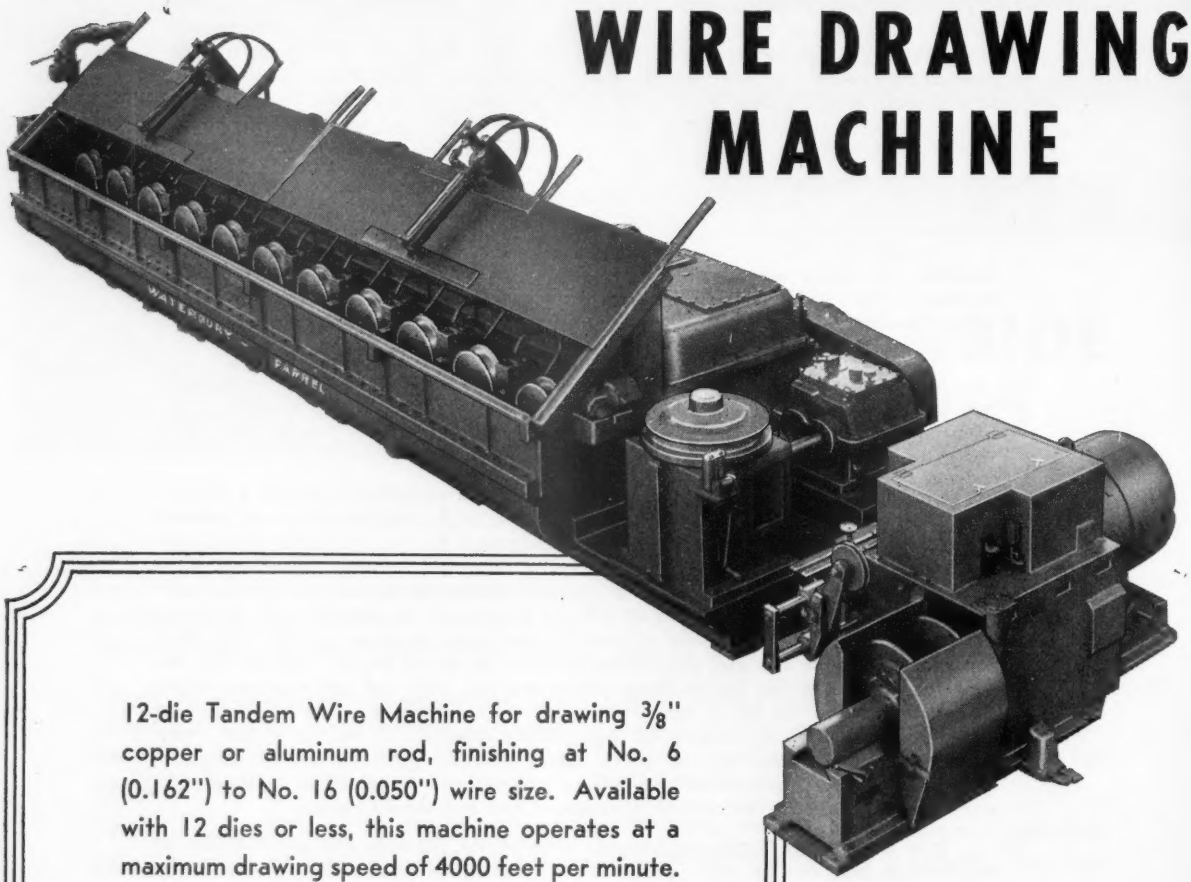

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WIRE AND WIRE PRODUCTS

A monthly publication devoted to the production of Wire, Rod and Strip, Wire and Rod Products and Insulated Wire and Cable.

DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 25 OCTOBER, 1950 No. 10

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Reg. 511,530 U. S. Pat. Off.

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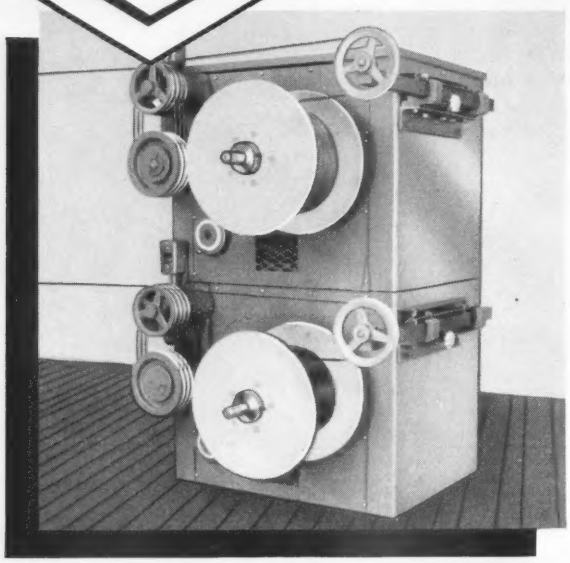

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WIRE
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A monthly publication devoted to the production of Wire, Rod and Strip.
DRAWING — ROLLING — EXTRUDING — FORMING — FABRICATING

Vol. 25 OCTOBER, 1950 No. 10

Neoprene Jacketed Telephone Wires

By C. C. Lawson
Wire Development Engineer
Bell Telephone Laboratories, Inc.
Murray Hill, N. J.

A paper presented before the Wire Association Convention at the Lord Baltimore Hotel, Baltimore, Maryland, October 23-26, 1950.

THE last five years have seen a very rapid change in design of the wires used for outdoor distribution of telephone circuits, particularly as regards the outer protective covering. These wires establish the connecting link between telephone cables or open wire lines and the subscriber's premises. They are expected to be in working order and to provide reliable service whether a hot sun is beating down on them or whether they are drenched by rain; whether the temperature is below zero or over 100° and whether coated with ice or subjected to the steaming humidity of the semi-tropics. Failures that may occur are costly not only in loss of revenue due to disrupted service but in a more important way, they are expensive because of repair or replacement cost involved in restoring service. These requirements and cost considerations call for wires having high strength, adequate conductivity, a good electrical insulation with excellent mechanical properties and a tough durable weather-resistant outer protective covering.

* * *

IT is this outer protective covering that is extremely important in maintaining continuity of service in the rubber insulated wires used in telephone plant. For this reason a jacket of neoprene compound has been chosen and is now used almost exclusively on telephone drop and similar wires. This material provides a continuous protective covering over the underlying insulation, a physical life far outstripping the former impregnated braid coverings coupled with a high degree of resistance to abrasion by tree branches and other objects. The use of neoprene as a jacket for these wires represents the biggest single step forward in wire design since the turn of the century.

* * *

IN order to bring out the magnitude of these changes in telephone wires that have taken place, it is well to consider the new wire coverings in comparison with the materials formerly used. The development can best be followed by using as an example drop wire which represents by far the most widely used insulated outdoor distributing wire.

* * *

Historical

THE name "drop" wire goes back to the days when telephone circuits were distributed on bare copper wires on crossarms attached to frames built on the roofs of buildings and the subscriber's connection was "dropped" to his premises below. The name has lasted even though the methods of distribution have gone through considerable change. One of the earliest forms of insulated drop wire, adopted about 1900, was a twisted pair of No. 14 copper wires each insulated with rubber compound and covered with a cotton braid saturated in asphaltic compound. Now after a half century, wire of almost identical design is still being manufactured but in the last very few years its use has been limited to specialized

purposes. However, the greater amount of wire is of more recent design employing bronze or copper-steel conductors to obtain higher strength with smaller size than was provided by the earlier copper conductors. Such higher strength conductors have been in use since approximately 1910. Further improvement in performance coupled with a decrease in cost was made possible by arranging the conductors in a parallel-pair configuration and covering the pair with a single protective layer rather than to separately insulate and protect the individual wires as in the twisted pair configuration. This change to the parallel construction was first adopted in commercial production in the late 1920's.

★ ★ ★

FROM that time until 1940, when the first neoprene jacketed telephone drop wire was produced, many improvements were made in the outside distributing wires with little, if any, change in general design. Such improvements related to changes in conductor materials to improve strength and permit use of smaller conductors without impairment in strength of finished wire, modifications in rubber compounding to provide better resistance to oxidation and ozone cracking and changes in the asphaltic braid saturants and finishes to provide greater resistance to abrasion and to deterioration by weathering.

★ ★ ★

Shortcomings of Cotton Braided Wires

THE weaknesses of impregnated cotton as a wire covering have been fairly well recognized; the rapid loss in strength of the yarns by the action of sunlight, water and fungi could be determined in a few months of outdoor weathering and typical results of such weathering tests are shown in Figure I. These samples comprised braided tubes of 16 ends of No. 10/2-ply unbleached cotton yarns saturated in a typical blended asphalt saturant. The braids were exposed in a rural location in New Jersey and the saturant was extracted before making the tensile tests.

★ ★ ★

SOME improvement in the performance of cotton was demonstrated when air blown asphalts were used as impregnants; these materials were fairly widely adopted on weatherproofed wires after publication in 1932 of the results of tests carried on at Purdue University in cooperation with The Utilities Research Commission, Inc. However, the higher temperatures of the baths of molten asphalt necessary to obtain complete impregnation of cotton yarns during the saturating operation were harmful to the rubber insulations employed in telephone wires although this was not a disadvantage in the case of the usual weatherproofed wire for power distribution where rubber compounds as primary insulation were not required.

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THIS loss in strength of the cotton yarns was responsible for failure of the wire when the protective braid became worn through by abrasion of tree branches or other contacting objects or when the braid was weathered away to expose insulation directly to sunlight and ozone attack. Subsequent cracking of the insulation caused rapid corrosion of conductor in common battery circuits which maintain a constant potential difference of 24 or 48 volts between conductors and between one conductor and ground. Such circuits are now used almost universally. In the older magneto circuits with no battery standing on the line, such exposure of conductor usually was not too troublesome until the two conductors actually shorted or one became grounded. Consequently the rate of corrosion was very slow and probably accounts for the widely held belief that the older wires were more durable than some of the more recent types.

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FAILURES in the braided wires through the loss of the outer protection might take as much as 15 or 20 years under mild weather exposure but such failures were known to happen within one or two years under the most unfavorable circumstances such as in the wet and humid conditions encountered around the Everglades

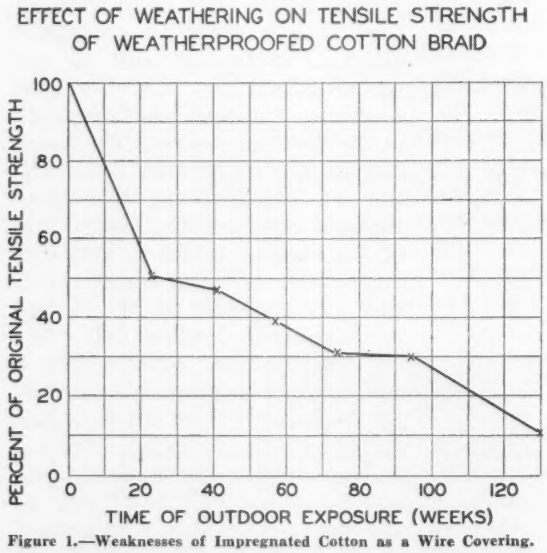
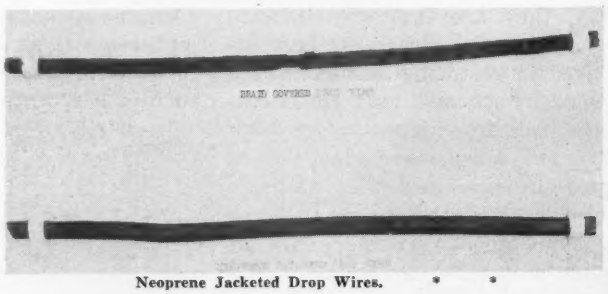


Figure 1.—Weaknesses of Impregnated Cotton as a Wire Covering.



Neoprene Jacketed Drop Wires. * *

Figure 2.—Drop Wires from Pahokee, Fla. (In service 2 years.) * *

in Florida. Figure II shows a photograph of weatherproofed cotton braid covered wire after two years service under these conditions. A sample of neoprene jacketed wire in similar service for the same length of time is shown to indicate the great improvement in performance demonstrated by the latter wire.

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IMPROVEMENTS were made in weatherproofed cotton braids such as increased size of cotton yarns, modified braid structure such as the use of circular loom, use of air-blown asphalt blends as saturants and the use of stearine pitch as a finishing coat. None of these, however, changed the essential weakness of cotton yarn braids in their vulnerability to deterioration by outdoor weathering.

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Early Neoprene Jacketed Samples

THIS then was the situation when in 1939 the development of neoprene by the duPont Co. had reached the stage where an odorless modification, Type G, had just been announced and when production of the synthetic material was increasing at a substantial rate thus giving promise of providing a material of general utility rather than a specialty material for use infrequently where its unusual characteristics made its adoption economically feasible. Additionally, the price had been substantially reduced with increasing production so that neoprene was rapidly becoming a material practicable for use as a wire covering. The price and availability of neoprene are charted in Figure III. The peaks in the curves of "Production" and "Wire and Cable Use" during the war years represent the large demands for neoprene by the Armed Forces in this period.

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EARLY in 1940, the first neoprene jacketed drop wire was made in the laboratory for trial. At that time, it was one of a number of experimental designs which were being tested in the laboratory and outdoors in an endeavor to achieve major improvements in the performance of drop wire. Neoprene was chosen for test because of its well demonstrated resistance to oxidation, to "sunlight" or ozone cracking and its good performance as a portable cord jacket. The jacketed wire comprised the usual insulated conductors with an extruded neoprene cover approximately 0.025" in thickness resulting in an over-all size approximating that of the braided wire.

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LENGTHS of this wire were placed in locations where the performance characteristics could be determined and checked against accelerated laboratory evaluations. One length was placed in Miami, Florida where it would be exposed to the maximum of sunshine and heat; another was placed in an exposure site in rural New Jersey while others were installed among trees for determination of resistance to abrasion in comparison with current braided wires. Figure IV illustrates a typical thicket where such abrasion tests are carried on.

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THE performance of these initial samples was excellent and indicated the desirability of further trials on a larger scale in actual service. In the summer of 1941, several thousand feet of neoprene jacketed wire were manufactured and subsequently installed in locations on both the East and West Coasts where braided wire exhibited undesirably short physical life. This wire was similar in construction to the earlier trial lot but the nominal thickness of the jacket was increased to 0.040" to provide increased resistance to abrasion.

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WHILE these service trials were even more successful than anticipated and pointed the way to early adoption of this improved wire, government restric-

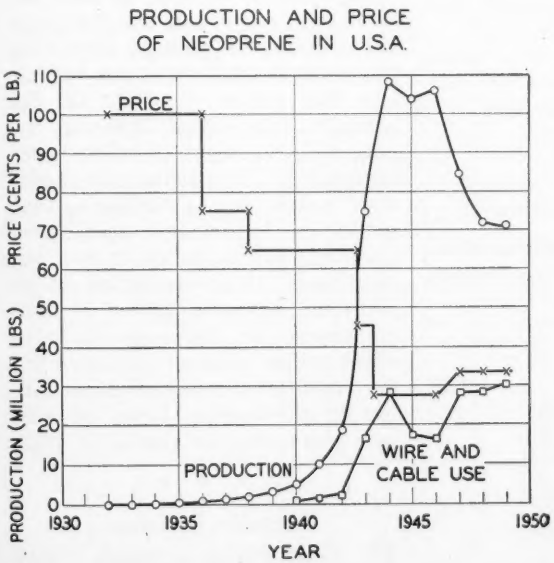

Figure 3.—Price and availability of neoprene. * * *

Figure 4.—Drop wires placed in an exposed site in rural New Jersey. * * * * * * * * * *

tions on the use of neoprene for other than military purposes postponed further production of wire for telephone use until early in 1945. At that time, production of an improved design of jacketed drop wire was undertaken on a limited basis using the maximum of neoprene which could be obtained on allocation for this purpose. Wires of this design differ from the earlier wires in having cotton reinforcement between the conductor insulation and the jacket as discussed under features of design. The majority of the drop wire now produced in the U. S. is of this design although there are several modifications including parallel pair construction without such reinforcement and twisted pair wire having a jacket over each of the insulated conductors.

* * *

Features of Design

SINCE the insulated conductors in the neoprene jacketed wire are essentially the same as in earlier wires, little need be said except that the general shape was revised to have each conductor in the center of a "D" section as shown in Figure V. The "D" sections are connected by a thin fin of insulation as illustrated.

* * *

COTTON reinforcement between the insulation and jacket provides two desirable characteristics; it serves as a separator permitting clean separation of the jacket from insulation when the jacket is removed for terminating the conductors; it provides reinforcement which reduces deformation under the compressive loads supplied by clamp-type supports used at pole and house attachments. A wire having such a reinforcement of cotton yarns will withstand crushing under loads applied by the clamps when the wire is maintained under a tension close to its breaking strength for a period several times longer than a similar wire without such reinforcement. The reinforcement may be applied either by serving or by braiding; the former is cheaper and is more effective as demonstrated in the type of test referred to above. A coverage of yarns calculated at approximately 75% of the insulated conductor surface provides satisfactory performance.

* * *

Jacket Compound

A NEOPRENE jacket compounded to conform to the physical requirements specified in American Society for Testing Materials Specifications for GR-M Polychloroprene Sheath Compound for Electrical Insulated Cords and Cables, Serial Designation: D-752 provides the characteristics desired in drop wire. Such compositions are well established in the trade and comprise 45 to 50% of neoprene polymer, 20 to 35% of a good carbon black, 0 to 20% of mineral filler, a small percentage of a recognized anti-oxidant, 15 to 25% of materials acting as processing and curing aids and approximately 3% of a suitable wax or wax blend. While each of the ingredients is important either in processing and curing the compound or to performance of the vulcanized jacket, the wax imparts two characteristics which are of a special value in obtaining good service characteristics in the wire for use outdoors. These are a high degree of resistance to ozone cracking when the jacket is stressed as at sharp bends in the wire and the provision of a smooth slippery coating on the jacket surface caused by slow exudation of the wax to the surface; this latter improves the resistance of the wire to scuffing and abrasion.

* * *

Performance Characteristics

THE weaknesses of cotton braid protection for drop wire which were discussed earlier led to service failures in the installed wire caused either by leaching out of weatherproofing and breakage of cotton yarns to expose the underlying insulation or by abrasion through the braid. The homogeneity of neoprene jacket as compared with weatherproofed braid offers continuous protection regardless of how thin it wears until it is completely worn through. As a consequence, since the compound does not weather away to any appreciable extent, the jacket will protect the insulation indefinitely unless it loses continuity by breaking or cracking. It is this type of failure then that it is anticipated will result in the eventual failure of jacketed wires. Consequently, the type of tests made on samples which have been exposed to various types of weathering are those which will indicate any trend toward degradation of this nature. Such tests include determinations of tensile strength and elongation of samples of jacket removed from the wire. Figure VI shows the changes in elongation and tensile strength plotted against years of exposure in the test plot at Miami, Florida. The changes indicate a stiffening of the compound with aging characterized by a slow increase in tensile strength and a decrease in elongation, rapid during the early months and then slowing down during the later aging period so that in the exposure time between 4 and 9 years the amount of change is within the experimental error for testing the thin jacket available on the samples. There does, however, appear to be a slight trend to lower elongation. This behavior on outdoor weathering is similar to that noted in laboratory accelerated tests and extrapolation from these data leads to a prediction of an estimated physical life of at least 20 years for neoprene jacketed wires when exposed outdoors under conditions known to cause failure in the earlier types of wire in a much shorter period of time.

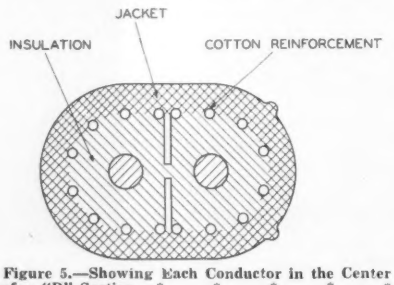

Figure 5.—Showing Each Conductor in the Center of a "D" Section.

* * *

Abrasion Resistance

IN determining abrasion resistance of the earlier samples of

neoprene jacket drop wire, it was soon found that the usual laboratory machines did not give reliable data in comparing the performance of these wires with the earlier braid covered wires. Consequently, a less accelerated outdoor test was employed almost exclusively. This test comprised stringing wire samples through dense growths of young trees in locations exposed to wind so that the wires were rubbed by the tree branches almost continuously. The advantage of using the small young trees in addition to the greater movement relative to the wires was that inspections could be made easily from the ground or by using a stepladder. Reference is again made to Figure IV showing a test site where many of the data on relative resistance to abrasion were obtained.

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RESULTS of this accelerated outdoor test are quantitatively expressed as a ratio of the performance of one wire as compared to other types of wire exposed in a similar manner. In Figure VII is charted the relative performance of the earliest samples of jacketed wire having a relatively thin jacket and the present form of jacketed wire compared with the superseded braided wires. The 4 to 1 improvement accounts for much of the superior performance of the jacketed wires in service. It is interesting to note that the greater abrasion resistance of the current wire as compared to the earlier jacketed wire is roughly in proportion to the relative thickness of the jackets.

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FREQUENTLY, where wires are of necessity run through trees, supplementary protection in the form of guards is applied to the wire at points of contact with tree trunks and heavier branches. Thus in the majority of installations the wire is rubbed by only the smaller branches and twigs. It is often observed that the jacketed wires are performing much better than would be expected from the data obtained in the accelerated outdoor abrasion tests described above. Such observations are checked by the results obtained in controlled field abrasion tests where the wires are subjected to less severe abrasion such as by the small tree branches and twigs usually encountered in service. Under such conditions, the tendency of the jacket compound to get tougher with age and to thereby increase in resistance to scuffing accounts for the much greater durability of the jacketed wire when compared with the former braided wires which lost strength and consequently resistance to abrasion rapidly during the early months of exposure. With these lighter contacts, abrasion resistance 10 to 20 times that of the cotton braided wires has been verified for the neoprene jacketed types.

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Effects on Field Performance

WHEN a new wire such as the neoprene jacketed drop wire is introduced it takes several years for it to replace the superseded wire in the working circuits. To replace the older wire wholesale would be obviously uneconomical. Consequently, the new wire is installed when new connections are being made and when it becomes necessary to replace one of the older wires either because of trouble which has developed in the circuit or because the wire appears to be in poor condition and is so reported at the time of a routine checkup. With such gradual replacement of existing plant by the new wire no rapid and spectacular reduction in troubles can be observed, the improvement showing up as a slow but steady improvement in performance for the whole wire plant. Observations of the trend in improvement in plant service results since the introduction of neoprene jacketed drop wire show for the past 5 years that drop wire troubles have been

(*Please turn to page* 933)

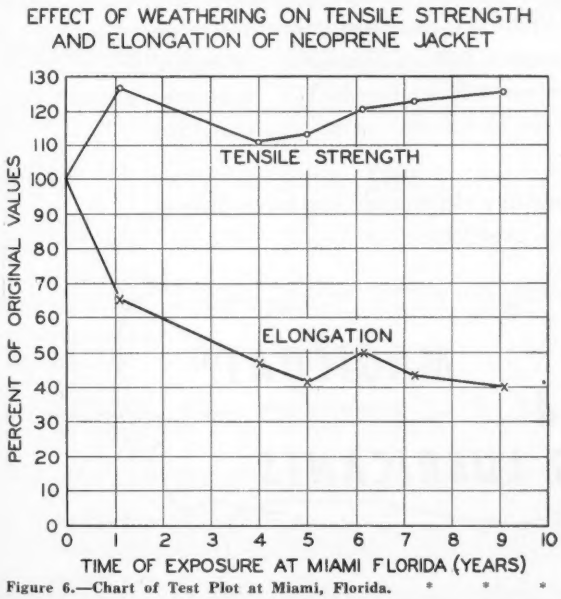

Figure 6.—Chart of Test Plot at Miami, Florida.

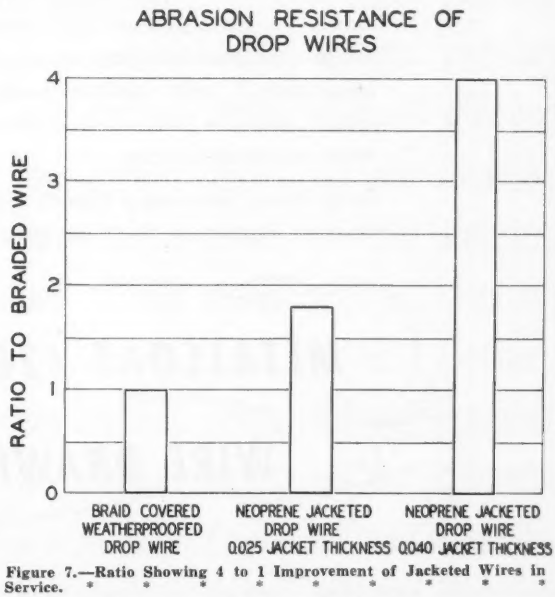

Figure 7.—Ratio Showing 4 to 1 Improvement of Jacketed Wires in Service.

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The Production and Applications of Copper-Base Alloy Wire

W. D. France[1], W. L. Wells[2], and W. E. Johnson[3]
Scovill Manufacturing Co.
Waterbury, Conn.

A paper presented before the Wire Association Convention at the Lord Baltimore Hotel, Baltimore, Maryland, October 23 thru 26, 1950.

THE myriad of uses and applications of copper-base alloy wire are generally well-known and as a result the copper-base alloys have become extensively used because of their versatile characteristics, dependability and wide range of commercially available alloys and tempers. In selecting a wire for any application, consideration must be given to cost, availability, and almost always a combination of characteristics such as strength, corrosion resistance, conductivity, spring properties, color, formability, machinability, fatigue resistance, ease of finishing, wear resistance, weldability, elevated temperature properties, etc. With full consideration of these characteristics, copper-base alloys have been unsurpassed in such major applications as pins, rivets, screws, chains, slide fasteners, tire valves, fourdrinier wire, brake linings, optical wire, hooks and eyes and fasteners, jewelry, hardware items, and others. It would be beyond the scope of this paper to discuss all of the applications of copper-base alloys or even to discuss the properties of all of the alloys which would suggest uses. For practical reasons it is planned to outline a few specific applications wherein certain alloys, typical of alloy groups, have been used extensively. This, in turn, will suggest uses for the other similar alloys and offer a general background as to why such a wide variety of alloys has been developed.

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Wire Applications

TUBULAR rivets are made extensively from Cartridge Brass, 70%, and Yellow Brass, 65%. These two similar alloys have excellent workability, relatively high strength and good corrosion resistance together with low cost. Of these, the main consideration is the capacity of the alloys to be severely cold worked without cracking, while creating moderate pressures in the mechanical processes. Several tempers are used, depending on the method of making the rivet. They range from a very light skin pass for straight hole extruded rivets to a draw in excess of one B & S number for the drilling process. Regardless of the final temper, the ready to finish grain size must be closely controlled.

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CARTRIDGE Brass, 70% and Yellow Brass, 65%, are examples of the plain copper-zinc series of alloys. This group varies in the proportions of copper and zinc from Muntz Metal containing 60% copper to Gilding Metal containing 95% copper. In general, the high zinc alloys offer maximum strength and hardness. Lesser amounts of zinc change the color and improve corrosion resistance, electrical conductivity and formability. In selecting an alloy for a particular application, most of the properties discussed previously would have to be considered.

FOR the production of tire valves, High-Leaded Brass, 63%, is used with excellent results. When furnished in an annealed temper of nominal 0.035 mm grain size, this wire can withstand the moderate amount of cold heading necessary and the lead facilities drilling, tapping and threading the outside of the valve. This application is typical of the uses for the wire alloys of the Copper-Zinc-Lead group. The lead serves the primary purpose of improving machinability. Since lead also reduces the capacity of the wire to be cold worked, a compromise must usually be made between machinability and the severity of the mechanical operations. The choice is not too difficult, however, since alloys are available from ½% to 3% lead and 56%—90% copper. As with the plain copper-zinc series, the higher copper alloys have the same relative advantages, independent of the presence of lead.

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SNAP rings for assembly in various types of fasteners are a good example of an application for another type of copper-base alloy wire. They are commonly made from Tin Brass, 5%, an alloy of 90% Copper, 5% Tin and 5% Zinc. This high copper tin brass offers good spring properties, excellent corrosion resistance, and good forming properties in very hard tempers. Wire for snap rings is normally furnished six to eight B & S numbers hard. The presence of tin is important in an application of this type, because it gives strength and spring properties not possible with a corrosion resistant high copper alloy in the plain brass series. The tin also improves corrosion resistance

1. Assistant Director of Research, Scovill Mfg. Co.
2. Assistant Superintendent of the Wire Mill, Scovill Mfg. Co.
3. Metallurgist, Scovill Mfg. Co.

above that expected for an alloy of equivalent copper without tin. Scovill produces alloys of this type in wire ranging from 60% to 95% copper and ½ to 5% tin. While this group finds its main use in corrosion resistant high strength applications, the tin gives a pleasing shade to the color, a characteristic which is valuable when the appearance of the finished product is important.

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FOR springs and spring applications where maximum strength and resiliency are required, a phosphor bronze alloy is generally used. These alloys differ from those discussed previously in that they do not contain zinc as an alloying element.

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OF the group, the two most common contain 5% and 8% tin, low residual phosphorus and the balance copper. The phosphor bronzes offer, in addition to high strength, excellent resistance to corrosion, good fatigue and spring characteristics, good mechanical characteristics at elevated temperatures, and surprising ductility even when drawn to spring temper. When selecting an alloy for the characteristics noted above, cost is very likely to be an important consideration because some of the copper-tin-zinc wires approach the properties of phosphor bronze at a substantial saving.

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THE final alloy group processed in the Scovill Wire Mill consists of the Nickel Silvers. A typical application for a wire of this type is in the manufacture of slide fasteners. Soft Nickel Silver, 18% (A) is very ductile and malleable. It can readily be formed into shapes for scoops and yet it work hardens rapidly in the mechanical operations to give high strength in the finished part. The silver color is very desirable in a slide fastener, as is the high degrees of corrosion and wear resistance. The nickel silver wire alloys range from 5% to 18% nickel, with copper usually a nominal 65% and the balance zinc. All of the alloys in the group have a pleasing silvery color and good resistance to corrosion. They can be formed by any of the usual manufacturing processes and when drawn to a spring temper, have excellent strength, fatigue and spring properties. As a result, nickel silver is used for some of the same types of items as is phosphor bronze. It is also used extensively in jewelry where the silver color can be utilized for itself or as a base for silver plating.

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IN the preceding discussion of the basic alloys produced in the Scovill Wire Mill, the emphasis has been put on the qualities which make an alloy suitable for certain applications. In practice, however, the approach must often be tempered with a consideration of the minimum requirements of the job in question. For example, the selection of too strong an alloy, even if strength is important, can be undesirable because of extra metal costs, or excessive stress and wear on the tools used for subsequent processing.

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OF equal importance to a choice of alloy is the selection of the proper temper. It is extremely dangerous to say that a given wire temper can be used for any particular item, because the method of making it or even variations in tooling for a given method can dictate the proper temper. It is not uncommon for the mill to furnish different wire tempers to several customers making exactly the same item. Consumers have realized that copper-base alloy wire can be furnished to closely controlled temper specifications. As a result, mill operations on the fifty-odd alloys must be designed to produce a tailor-made product for almost every order. We must work both to standard wire specifications as published by ASTM and SAE and to individual specifications established by the customers' engineers, the customers' past experience, or our own technical service engineers.

Wire Production

TIGHT controls on temper have their basis in careful mill supervision and good mill practice. In order to hold a narrow specification on tensile strength, for example, special precautions must be taken to control the ready to finish anneal, the ready to finish gauge, and the final gauge all within very close limits. The method of doing this can be described by examining the equipment and methods employed in the Scovill Wire Mill.

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THIS mill produces from roughly half a hundred alloys, wire and rod, from 5/16″ down to .006″, and is essentially a job shop, because order requirements vary from coil weights of one pound to three hundred pounds and inside diameters from six inches to twenty-four inches. It is imperative, therefore, that maximum flexibility in layouts and equipment be maintained. The material to be finished as wire is cast in the Scovill Casting Shop either as billets for extrusion or bolts for rod rolling. As much as possible of the wire stock is cast in the continuous casting machine and then extruded. The details of this process in the Scovill Mfg. Company have previously been covered in a paper by W. D. France and L. E. Thelin,[1] so a further description will not be given at this time.

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REDRAWING material for the Wire Mill is either drawn round or tandem rolled square to sizes of approximately 11/32 of an inch in the Rod Mill. After these cold operations, the stock is ready to be processed into wire.

Storage and Handling

COILS received in the Wire Mill are handled by a ram lift jitney and stored in bins. After the first operation in the mill, they are carried on specially designed skids and stored on racks as illustrated in photograph No. 1. In the interest of efficient flow, work is always delivered to one side of a machine and removed from the

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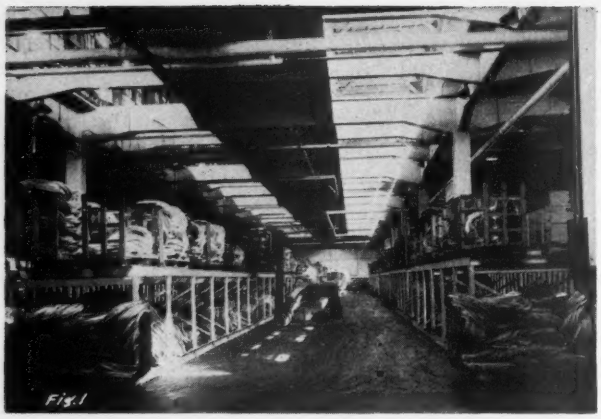
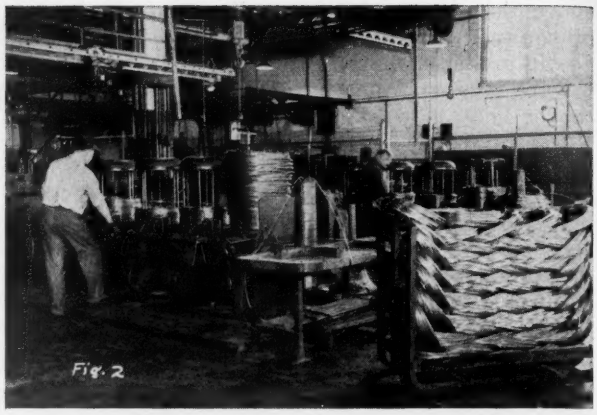
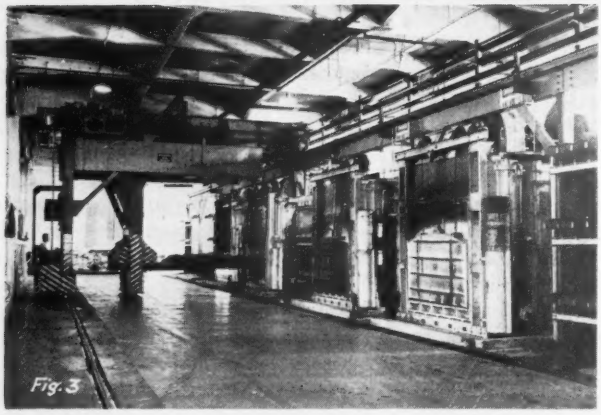
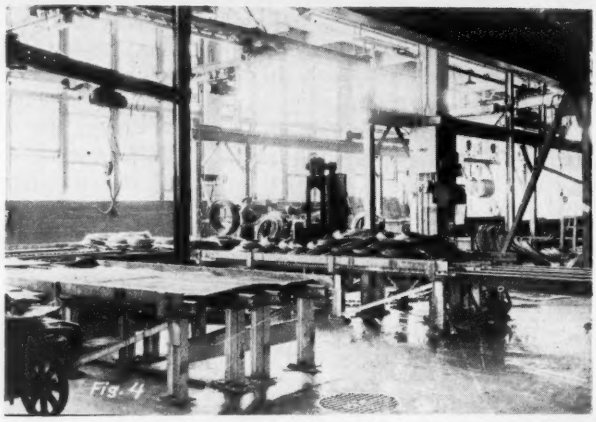
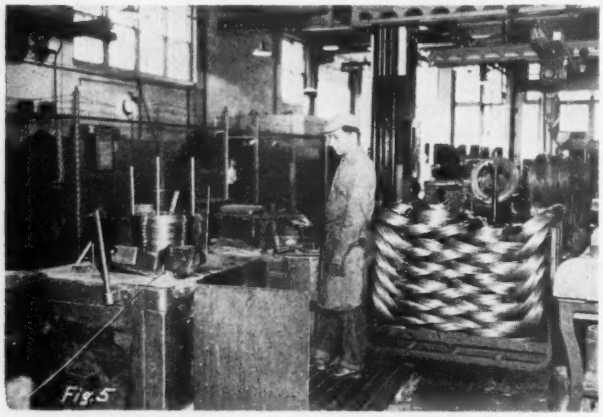
1. "Production of Copper-base alloy Rod by Hot Extrusion" published in the AIME Rod and Wire Production Practice volume of 1949.











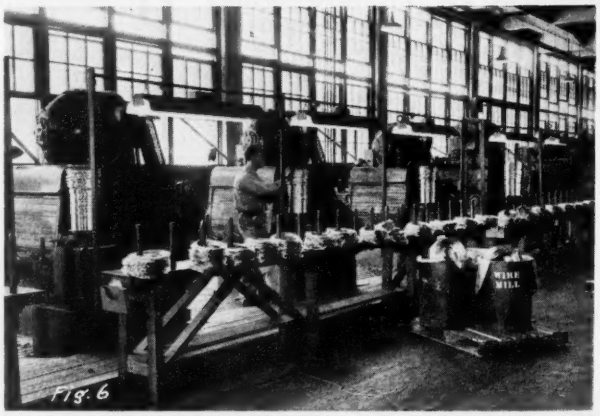


Fig. 1.—Coils carried on specially designed skids and stored on Racks.

Fig. 2.—Morgan Multiple Die Tandem Machine for Large Reduction.

Fig. 3.—Propane Fired Batch Furnaces.

Fig. 4—Conveyor Table in Pickling Unit.

Fig. 5.—Single Blocks Used for Heading Wire and Other Jobs where Final Drawing Is Light.

Fig. 6.—Waterbury-Farrel Upright Cone Machine.

other. Emphasis is placed on having a minimum of work in process at any given working point and maintaining a maximum available floor area. Individual applications of this principle will be noted as the various items of equipment are discussed.

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Dies

ALL dies, except diamonds, are finished in the Mill from rough cored nibs. Tungsten carbide is used exclusively down to .050″. The final die below this size is always a diamond with tungsten carbide dies as low as .025″ used in the running down positions of continuous machines. As the dies wear, they are opened up to larger sizes.

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Running Down

WHERE the alloy is weldable and the required reduction is

large, running down is accomplished on Morgan multiple die tandem machines as shown in photograph No. 2. The maximum reduction on these machines, using four dies, is eighty per cent. Dry soap powder is used exclusively as a lubricant. For alloys which cannot be successfully welded and on jobs where the draw is light or the quantity is very small, single die machines are used. The running down lubricant for these machines is usually a soft sodium soap cylinder oil grease and sometimes a soap solution. Reductions up to fifty per cent in area are possible on most alloys.

* * *

Annealing

ALL annealing is done in batch type, single end, propane fired furnaces as illustrated in photograph No. 3. Uniformity of anneals is achieved by the use of recirculating atmospheres, automatic control equipment, standardization of charge weight, and rigid adherence to established time cycles. The wide variety of alloys and grain size specifications makes routine sampling and testing of annealed wire essential. All metal is handled by a gantry crane which services all muffles and the pickling units.

* * *

Pickling

SINCE the muffle atmosphere is only slightly reducing, the resulting scale must be removed by pickling. Each muffle load of annealed wire is delivered to the conveyor table of the pickling unit; photograph No. 4. There it is pointed if necessary, picked up by a floor operated bridge crane, and processed through various pickling and cleaning cycles. The most commonly used pickling and cleaning solutions are sulfuric acid 12%, sodium bichromate five ounces per gallon and sulfuric acid, 5%, chromic acid six ounces per gallon and sulfuric acid 4%, potash and a commercial alkali cleaner and soap solution.

* * *

Finishing

AS in the running down operation, the percentage of the reduction and weldability of the alloy as well as the finish size determines the equipment to be used for finishing. Photograph No. 5 shows how single blocks are used for all heading wire and other jobs where the final draw is relatively light.

* * *

SOAP solution is used almost exclusively as a lubricant because it offers excellent lubricating properties and gives a clean, bright finish to the wire.

* * *

WHEN the draw is heavy enough to justify multiple die equipment, one of three sizes of Waterbury Farrel Upright Cone machines is used. Reductions up to ninety per cent in area are accomplished by the use of up to ten dies as shown in photographs Nos. 6, 7, 8. Speeds as high as two thousand feet per minute are used, the exact speed for each job depending upon the reduction and the alloy. All dies and rolls are lubricated from a central reservoir. The lubricant is a dilute aqueous emulsion, slightly acid, which duplicates the properties of the fermented bran type lubricants used in the past years. Wherever necessary, because of coil weights and sizes, mechanical strippers are utilized. Wire from the finishing blocks is placed on pegs where it can be inspected and packed for shipment.

* * *

Inspection

ALL wire is given one hundred per cent inspection for surface, proper alloy, size, color and general appearance. This is illustrated in photograph No. 9. The inspectors break a piece from each end of every coil and check the appearance of the break for alloy. At the same time, the cross section is examined critically for evidence of unsoundness. Doubtful cases are verified by chemical analysis or microscopic examination and out-of-roundness specifications are checked by gauging these same samples. The coils are fanned open and the wire examined thoroughly for surface defects, uniformity of color and undesirable conditions such as chatter. Samples from each end of every coil are also subjected to a twist test for protection against metal defects which are not visible to the naked eye.

* * *

FURTHER samples, selected on a quality control basis, are sent to the laboratory for analysis, tensile strength, grain size or whatever type of test is necessary for

(*Please turn to page 936*)

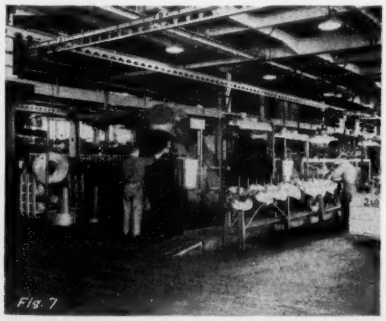
Fig. 7

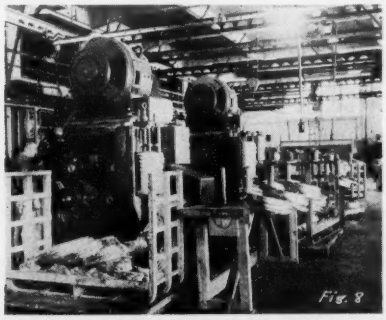
Fig. 8

Fig. 9

Fig. 7 and 8.—Reductions Up to 90% Area with Use of 10 Dies. * * * * * *

Fig. 9.—Inspection for Surface Defects, Size, Color and General Appearance. * * * *

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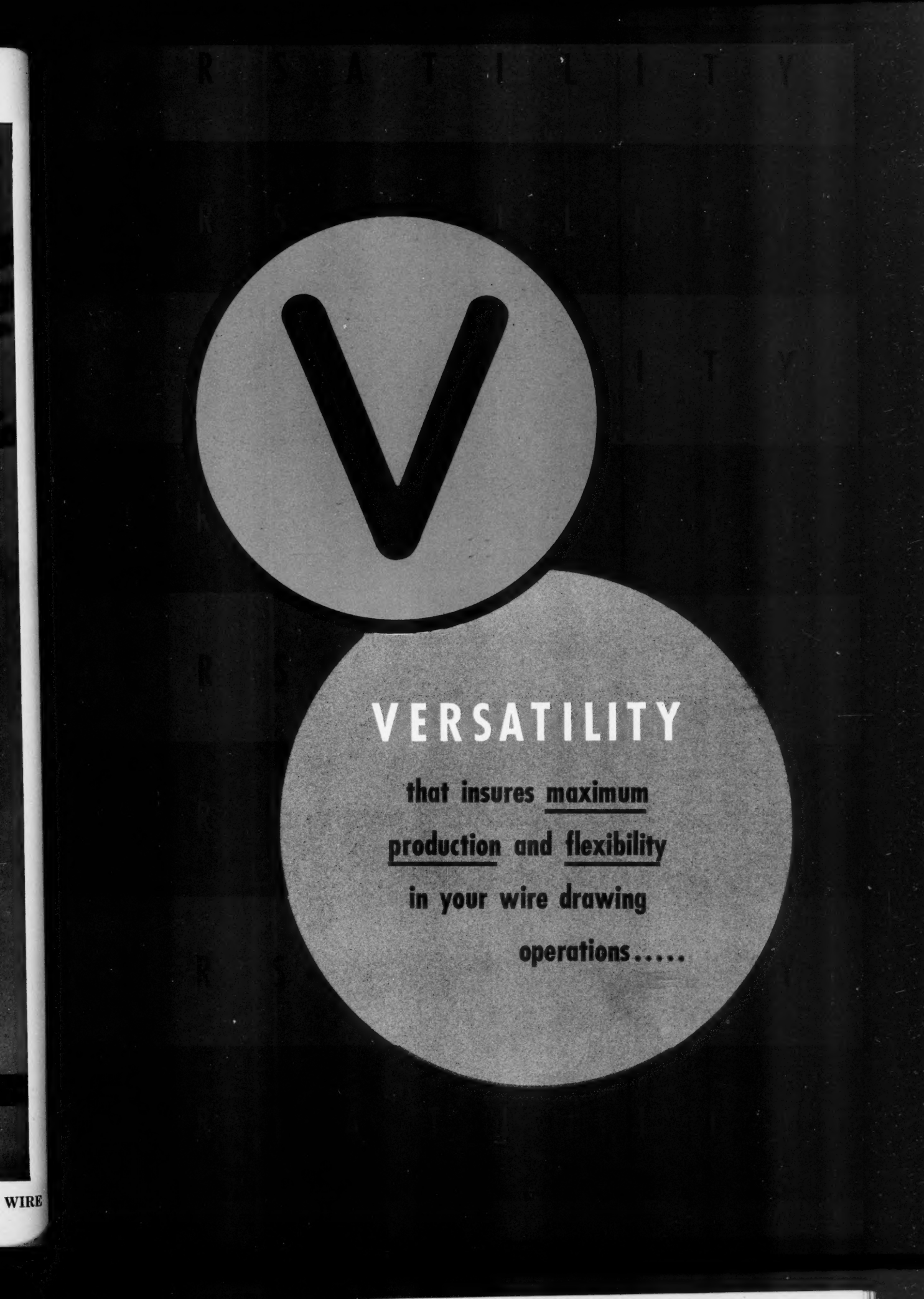
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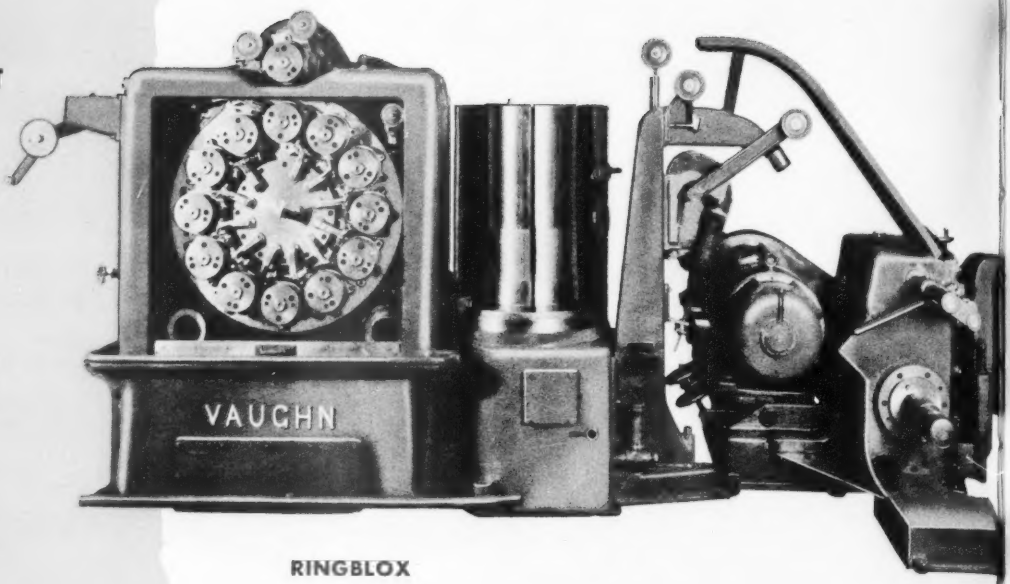

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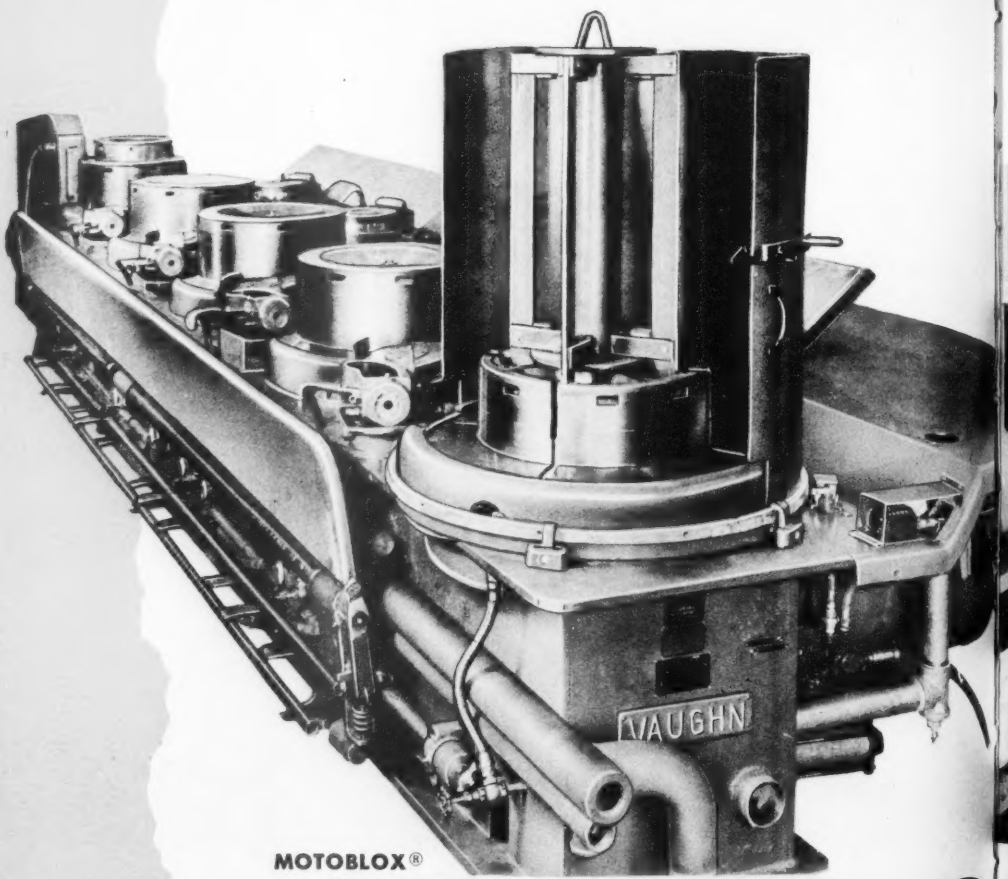

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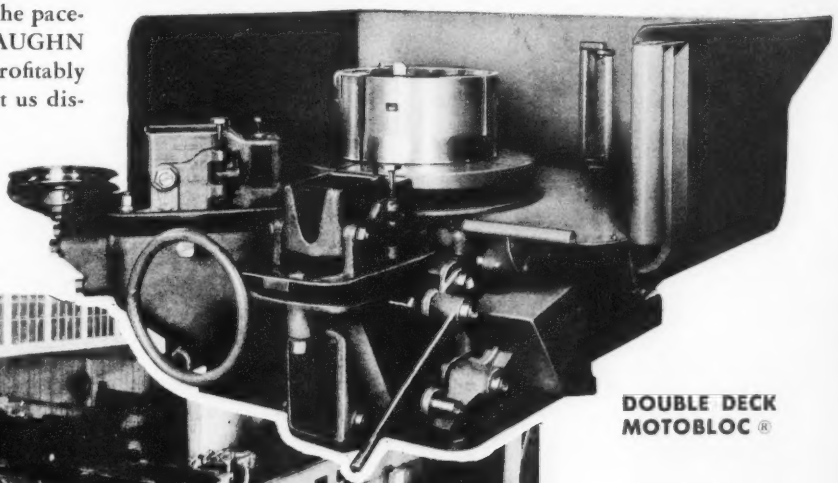

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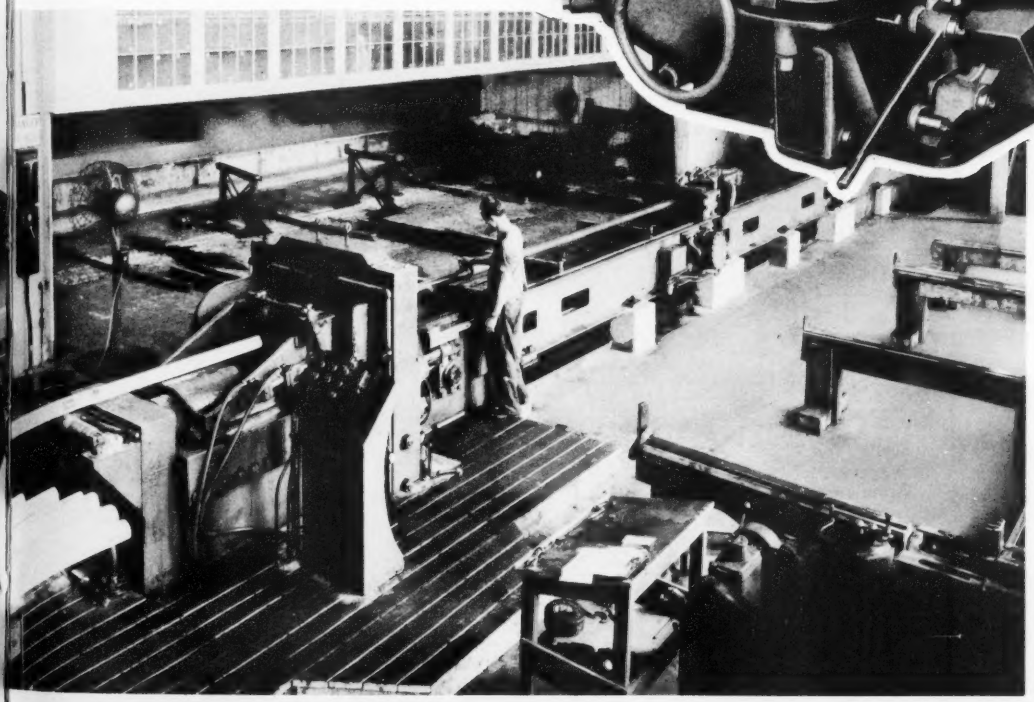

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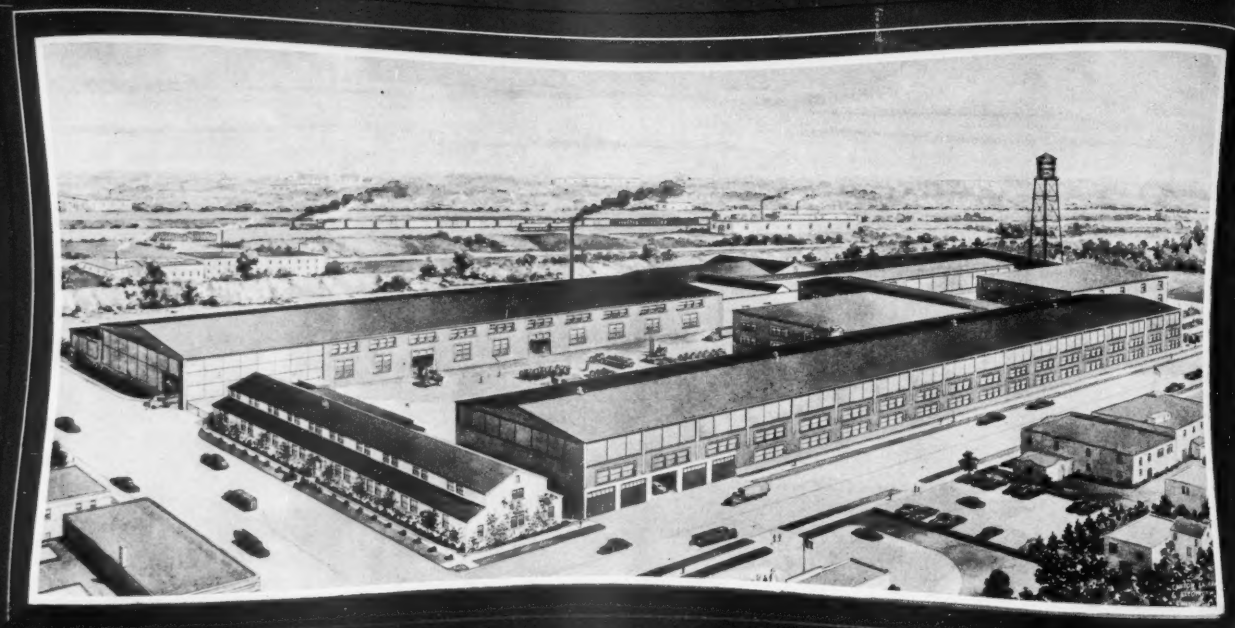

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Steel Welding Wire

By

G. E. Claussen and H. E. Sincock

Reid-Avery Company, Inc.

Dundalk, Baltimore, Md.

STEEL welding wire is produced by steel mills for further processing into finished welding rods and electrodes by welding wire manufacturers. The consumers, in turn, use about 200,000 tons of welding wire each year as filler metal in welded joints in the construction of a wide variety of products, such as ships, tanks, buildings, and pipe lines. The variety of products in which welding wire is used creates a variety of situations in which it must perform satisfactorily. To meet the very numerous requirements of most of these situations, a relatively few types of welding wire are on the market. The principal types are listed below. Welding wire for stainless steels and nonferrous metals is not considered in this tabulation.

★ ★ ★

A paper presented before the Annual Convention of the Wire Association, October 23-26, 1950 at the Lord Baltimore Hotel, Baltimore, Maryland.

Principal Types of Welding Wire for Plain Carbon and Low Alloy Steels

1. Wire for open arc welding.
   (a) electrodes with a heavy extruded covering used principally for manual welding, but also for automatic welding.
   (b) electrodes with a light wash or drawn coating used principally for automatic welding, but also for manual welding.
2. Wire for submerged arc welding.
3. Wire for gas welding.
4. Wire for inert gas arc welding and for other processes, such as atomic hydrogen and carbon arc welding.

★ ★ ★

Table One

Chemical Composition of the Principal Grades of Welding Wire for the Major Welding Processes that Require Filler Material.

	% Carbon	% Manganese	% Phosphorus Max.	% Sulfur Max.	% Silicon	
Wire for open arc welding.						
Extruded Electrodes						
low carbon	.10-.15	.40-.60	.025	.035	.03 Max.	Rimmed
medium carbon	.30-.40	.40-.60	.025	.035	.10 Max.	
high carbon	.65-.75	.60-.90	.025	.035	.25 Max.	
Lightly Coated Electrodes.						
low carbon	.10-.15	.40-.60	.025	.035	.03 Max.	Rimmed
high carbon	.60-.70	.90-1.30	.025	.035	.25 Max.	
Submerged Welding						
plain carbon	.10-.15	.40-.60	.025	.035	.03 Max.	Rimmed
2% manganese	.11-.17	1.80-2.30	.025	.035	.05 Max.	
Gas Welding						
dead soft plain carbon	.06 Max.	.17 Max.	.025	.035	.03 Max.	Rimmed
GA50	.10 Max.	.40-.60	.025	.035	.10-.20	Killed
higher tensile GA60	.13-.18	1.00-1.20	.025	.035	.20-.30	

THE composition of the principal grades of welding wire for the different welding processes is listed in Table One. These compositions are among the most important grades, although there are many other grades in use that cannot be included in this discussion. The steel mills exercise strict control over welding wire heats to meet the composition limits and any additional welding tests that may be required by the welding wire manufacturer. Particularly in the rimmed grades the welding quality of a wire may be related as closely to the steel making practice as to the chemical analysis. Accordingly the manufacturer may be forced to specify a welding test in order to avoid receiving steel of correct analysis yet unsatisfactory welding behavior.

★ ★ ★

THE sulfur content should be as low as possible in all steel welding wire. It is believed that if the sulfur content of wire for extruded electrodes of E6010 and E6020 types could be held to 0.020% maximum, the welding behavior on steel plate would be improved, and the sulfur limit for the plate itself could be raised.

★ ★ ★

BESIDES adherence to specified composition limits, the welding wire manufacturer requires uniformity in the steel. The rim of rimmed steel should be uniform from heat to heat, and cropping should be sufficient so that none of the segregated areas (high sulfur and carbon) of an ingot is included in welding wire. While rimmed steel for welding wire may be classified as dirty steel, it is

made with unusual care and is free from slivers.

★ ★ ★

AFTER a heat of steel for welding wire is poured, it is hot rolled to rod in the usual way. The steel then is cold drawn to size. The temper of the steel after cold drawing is of some importance if the wire is to be coiled for automatic welding. Too stiff a wire may break in the feed rolls of an automatic welder, whereas too soft a wire may kink.

★ ★ ★

ALTHOUGH the temper is not generally important, the surface of the wire after cold drawing is a primary consideration. For extruded electrodes an "extra dry clean bright finish" is important* to secure good adhesion of the extruded coating. Grease drawing is preferred to soap drawing for surface cleanliness. The surface of bare wire for submerged arc welding sometimes is lubricated very slightly to prevent sticking in the nozzle of the welding head. Wire for inert gas arc welding sometimes requires special surface cleanliness to prevent porosity in the welds.

★ ★ ★

Heavy Covered Electrodes

THE welding wire manufacturer places two main requirements on the steel he receives, namely: uniformity and surface cleanliness. The consumers, meanwhile, are placing a large number of requirements on the finished welding rods and electrodes. Dealing first with extruded electrodes for open arc welding, we find the basic requirements summarized in the well-known specifications of the American Welding Society.** They call for sound welds of specified size, contour, strength, and ductility deposited by electrodes capable of operating in specified positions. Additional requirements imposed by some consumers are, for example, ability to weld coated steel, easy slag removal, specified notch impact value, or a wide range of operating currents.

★ ★ ★

THESE requirements are met by suitable combinations of core wire and coating. The coating must be designed for the core rod, which must be uniform from year to year if the coated electrode is to be uniform in quality. To illustrate the effect of the core rod on electrode characteristics, six different core wires 3/16 inch diameter, Table 2, were coated with three different fluxes, Table 3.

★ ★ ★

THE fluxes were designed for the 15 CR wire. Wires 02C,

Table Two

Composition of Steels Used for Experimental Covered Electrodes.

	C	MN	P	S	Si
02C	.02	.03	.005	.025	NIL
05C	.05	.12	.020	.033	NIL
15CR	.15	.43	.016	.022	NIL
06CK	.06	.41	.018	.028	.16
09S	.13	.54	.020	.092	NIL
70C	.69	.55	.023	.022	.15

Table Three

Composition of Coatings Used for the 3/16" Experimental Electrodes.

Type of Flux	6012	7015	6020
SiO_2	19.7	7.0	38.7
Si	----	5.4	----
Mn	6.2	2.1	14.6
FeO	1.1	----	----
Fe_3O_4	----	----	26.9
Fe	2.8	7.2	4.2
CaO	2.2	30.9	1.7
CaF_2	----	21.0	----
TiO_2	52.3	6.6	----
Al_2O_3	1.5	1.0	2.3
MgO	3.5	----	0.4
Na_2O	2.6	1.3	2.5
K_2O	1.7	0.8	1.1
Volatile *	6.3	16.7	7.6
Outside diameter, inch	0.226	0.280	0.264
Ration ‡	0.12	0.26	0.24

The composition is expressed in percent by weight of the dry flux.

* Volatile at the temperature of the weld puddle, such as organic materials and CO_2 from calcium carbonate.

‡ Ratio = $\frac{\text{weight of coating per inch}}{\text{weight of coating per inch} + \text{weight of core per inch}}$

* Steel Products Manual; Section 16: Carbon Steel Wire, pages 26 to 29, American Iron and Steel Institute, July 1947.

** Tentative Specifications for Mild Steel Arc-Welding Electrodes, A. W. S. Designation A5.1—48T.

05C and 70C were used to show the effect of carbon and manganese, wire 06CK the effect of silicon killing, and wire 09S the effects of sulfur. The three fluxes are representative of well-known types conforming on wire 15CR to American Welding Society classes 6012, 7015, and 6020.

★ ★ ★

The 6020 Electrodes

FLAT fillets were made in ½ inch plates with each electrode. Of the core wires coated with 6020 flux, only 15CR produced sound welds at 180 amperes, straight polarity. The fillets made with the other five core wires were very porous. Cracks were found with wires 09S and 70C. No further tests were made with the 6020 coating. It is well established that 6020 electrodes are sensitive to small variations in core wire analysis.

★ ★ ★

The 6012 Electrodes

FILLETS made at 180 amperes, straight polarity with the 6012 type were free from external porosity. The 09S weld cracked throughout its length. When the fillets were fractured, the 70C fillet was found to be very brittle, the 06CK fillet was rather brittle, and the 02C, 05C, and 15CR fillets were tough. The 02C and 05C fractures exhibited a little more porosity than 15CR.

★ ★ ★

VERTICAL fillets, both up and down, were made with each 6012 electrode. The 09S electrode was more fluid than the others. The 70C electrode was sputtery and did not penetrate well into the root of the weld. The 06CK electrode also had insufficient root penetration. From the standpoint of usability the 02C and 05C electrodes were similar to 15CR.

★ ★ ★

THE deposit time, expressed in seconds required to deposit one inch of electrode, was found to be 6.4 seconds per inch for 02C, O5C, 15CR, and 09S electrodes at 180 amperes, 22 volts, straight polarity. The 06CK and 70C electrodes were faster: 5.7 seconds per inch. On reverse polarity the deposit time was about the same for the six electrodes, namely: 6.1 to 6.4 seconds per inch at 180 amperes, 22 volts.

★ ★ ★

THE composition of the weld metal deposited by the electrodes is given in Table Four. The sulfur gained by the deposit is due to the sulfur content of the coating materials.

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The 7015 Electrodes

FLAT fillets were made in mild steel plates ½ inch thick at 210 amperes, 24 volts, reverse polarity and were broken for examination of the fracture. The 15CR and 06CK electrodes produced tough welds free from porosity. Porosity appeared at the root of fillets made with the 02C and 05C electrodes. Although the 09S fillet was not porous, it was brittle. The 70C fillet had hot cracks over three quarters of its length, and was porous. The deposit time was 6.4 to 6.8 seconds per inch for the six electrodes.

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FROM the standpoint of usability, the 02C and 05C electrodes produced a great deal more spatter than the others. On straight polarity the six electrodes created more spatter and deposited rougher beads than on reverse polarity, although the deposition rate was a little faster.

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THE composition of the weld metal deposited by the 7015 electrodes is given in Table Four. Unlike 6010, 6012, and 6020 coatings, the 7015 coating being semi-basic, absorbs sulfur from the weld metal. As a result the 7015 weld metal has less sulfur than the core wire.

★ ★ ★

SUMMARIZING the results on heavy covered electrodes, we see that changes in the carbon, manganese, silicon, and sulfur contents of the core wire have decided effects on porosity, cracking, and usability. The variations in the present experiments were made intentionally large to magnify their effect. Smaller changes in core wire composition, only slightly beyond the limits in Table One, have proportionately smaller effects on welding. However, these effects, although small, become observable only too readily when the behavior of electrodes having off-standard core wires is compared on a critical application.

★ ★ ★

OF the steels for open arc welding in Table One, the low-carbon rimmed steel is by far the most important. The high-carbon

Table Four

Composition of Weld Metal Deposited by the Heavy Covered Experimental Electrodes.

	C	Mn	P	S	Si
6012 Coating 02C Wire	.03	.15	.010	.024	.11
" " 05C "	.04	.20	.024	.035	.13
" " 15CR "	.05	.29	.020	.029	.13
" " 06CK "	.05	.27	.023	.031	.17
" " 09S "	.06	.30	.026	.094	.16
" " 70C "	.35	.46	.026	.027	.30
7015 Coating 02C Wire	.04	.20	.010	.013	.18
" " 05C "	.05	.26	.022	.022	.22
" " 15CR "	.08	.49	.017	.020	.27
" " 06CK "	.07	.45	.019	.018	.33
" " 09S "	.08	.51	.020	.052	.25
" " 70C "	.51	.66	.024	.020	.45

The chemical analyses were made on drillings from pads of deposited metal one inch length three inches square, using 180 amperes straight polarity for 6012 electrodes and 210 amperes reverse polarity for 7015 electrodes.

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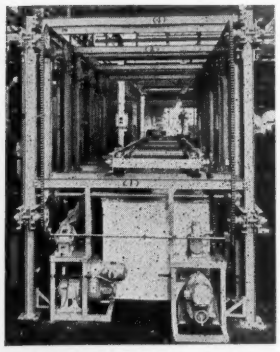

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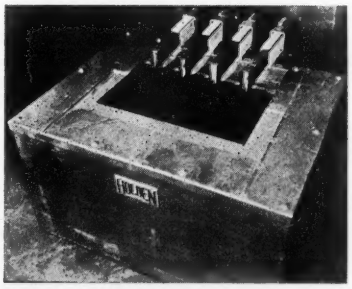

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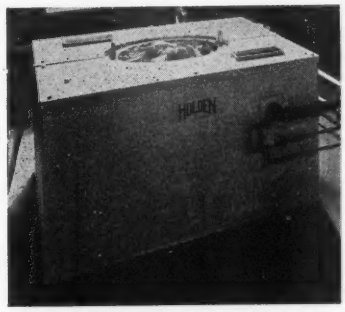

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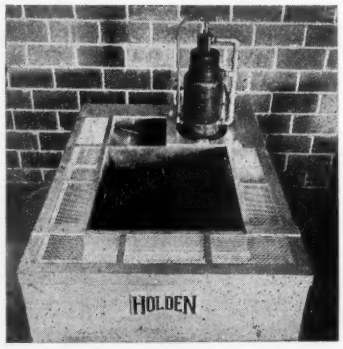

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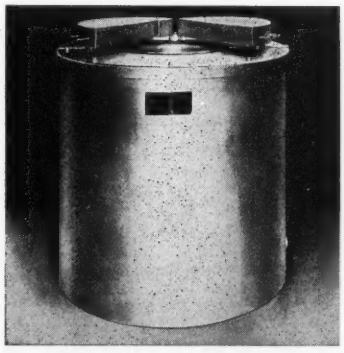

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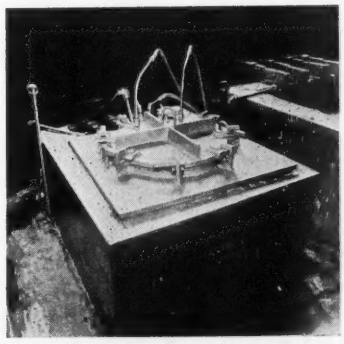

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wires are used as hard surfacing electrodes.

★ ★ ★

Light Coated Electrodes

THERE are four principal types of bare or light coated electrodes.

1. **Bright drawn electrodes, generally confined to higher carbon grades and welded on reverse polarity.**
2. **Sull coated electrodes. The wire is allowed to rust under controlled conditions and then is drawn with the aid of calcium carbonate (lime). The resulting rust or sull coating improves the weldability by stabilizing the arc. Sull coated low-carbon wire of Type One (b) in Table One generally is classified as E4510 and is used principally for manual welding.**
3. **Mineral coated electrodes. The wire is coated with a wash containing mineral fluxing ingredients, such as titanium dioxide, and then may be drawn. Mineral coated low-carbon wire is classified as E4520 and is used principally for automatic welding.**
4. **Knurled electrodes. The wire is knurled to provide space for more flux than can be applied to Types 2 and 3. The knurling also cleans the welding nozzle. The flux, as in Type 3, is designed to increase the maximum current at which the wire will operate. Knurled electrodes are used exclusively for automatic welding.**

★ ★ ★

THE amount of coating on Type One bright drawn electrodes is minute, yet the surface condition may materially affect operating characteristics, particularly in the low-carbon grades. The coating on Types 2 and 3 usually does not exceed 0.1% of the weight of the wire. On Type 4 the coating amounts to 0.5% or more of the weight of the wire.

★ ★ ★

THE principal purpose of the coating on Types 3 and 4 is to increase the maximum current at which the uncoated electrode will operate without producing burnt welds. By a burnt weld is meant a weld bead with small holes down the center. The coating performs its function by stabilizing the arc and by suppressing the formation of large globules of molten metal at the arc.

★ ★ ★

IN the absence of a coating, the stability of the arc, which is evaluated by the tendency toward globule formation, depends on the welding wire itself. Of the steels in Table One, for example, the best bead was obtained with Steel 15CR, Table Five. In these tests the 3/16 inch wires were rubbed with emery cloth before welding to remove drawing compound. In practically every instance the tendency toward globule formation was intensified by removal of the compound. In other words, the slight film of drawing compound on a steel wire improves its weldability as a "bare" electrode, but has no effect when the wire is coated with a wash or extruded flux.

★ ★ ★

WE do not know the reason for the dependence of globule formation and tendency to burnt welds on the chemical composition and on drawing compounds. Since annealed wires show the same behavior as cold drawn wires, hydrogen seems to be eliminated as a factor.

★ ★ ★

IT has been thought that the surface tension of the globule of steel itself or of the oxide film on the globules may be the determining factor for the formation of large globules. Alloying elements such as aluminum, silicon, and chromium produce oxide films of high surface tension on molten steel, and therefore should favor large globules in welding. As a matter of fact, these elements are known to favor globule formation. A moderate content of manganese, in the absence of these elements tends to suppress globule formation especially on straight polarity.

★ ★ ★

FOR the welding tests in Table 5 the wires were deposited as

Table Five

Manual Welding Tests with the Bare 3/16 Inch Welding Wires of Table One.

Wire*	Straight Polarity, Direct Current					Reverse Polarity, Direct Current				
	Amperes	Volts	Deposit Rate Sec/Inch	Tendency to Globule Formation	Tendency To Burnt Welds	Amperes	Volts	Deposit Rate Sec/Inch	Tendency to Globule Formation	Tendency To Burnt Welds
02C	170	28		Yes	Yes	200	24	5.0	Slight	Yes
06C	200	20	6.0	Slight	Slight	200	24	5.3	Yes	Yes*
15CR	170	23	4.4	Slight	No	200	20	5.3	Yes	Slight
15CK	160	26	4.1	Yes	Slight	190	24	4.7	Slight	Pronounced
09S	170	26	6.1	Yes	Slight	180	24	4.9	Yes	Pronounced
70C	140	34	5.2	Pronounced	No	180	26	5.2	Pronounced	No

* These tests were made with wires whose surface had been cleaned thoroughly with emery cloth. It should be remembered that scarcely visible coatings of rust, drawing compound, etc. considerably improve the arc stability of the wires. It should be kept in mind also that differences in steelmaking procedure among different heats of the same type of core wire may greatly affect bare electrode performance without being reflected in the routine chemical analysis.

Table Six

Composition of Weld Metal Deposited by Bare and Light Coated Electrodes, 3/16 Inch Diameter.

Rod	WIRE					WELD METAL**				
	C	Mn	P	S	Si	C	Mn	P	S	S
05C	.05	.12	.020	.033	NIL	.02	.08	.022	.035	NIL
15CR	.15	.43	.016	.022	NIL	.02	.34	.016	.022	NIL
06CK	.06	.41	.018	.028	.16	.01	.23	.018	.028	.04
09S	.13	.54	.020	.092	NIL	.02	.26	.020	.090	NIl
70C	.69	.55	.023	.022	.15	.35	.42	.023	.022	.09
Knurled*	.15	.45	.020	.026	NIL	.03	.24	.020	.026	NIL

** The chemical analyses were made on drillings from pads of deposited metal one inch high, two inches wide, five inches long using 200 amperes, straight polarity.

* A commercial knurled wire for automatic welding. The coating amounted to 1.0% of the weight of the wire..

beads in the flat position on 5/16 inch steel plates. The welding generator was adjusted to produce a satisfactory weld with Steel 15CR on straight polarity. With this setting the six wires were deposited on straight and reverse polarity. With Steel 15CR it was necessary to hold a shorter arc on reverse than on straight polarity to avoid large globules. Since globule formation is particularly harmful in vertical welding, straight polarity is used in practice with electrodes of Type 15CR. Steels 05C and 09S were similar to 15CR in having better weldability on straight polarity than on reverse. However, as the higher voltages indicate, 05C and 09S tended strongly toward globular transfer on reverse polarity.

★ ★ ★

STEELS 02C, 06CK, and 70C were more stable on reverse polarity than on straight. The 02C and 15CK wires had somewhat better arc characteristics on reverse polarity than 15CR. The latter, nevertheless, deposited the soundest welds. Even lowering the current to 130 amperes, reverse polarity, did not prevent a slight amount of porosity on the surface of beads deposited by the 06CK and 02C wires. The 02C wire was extremely globular on straight polarity at all currents from 130 to 270 amperes.

★ ★ ★

ON both polarities the dust alongside 02C and 05C beads was bright red, whereas alongside 70C beads the dust was gray, and alongside the 06CK, 15CR, and 09S beads the dust was orange. The bright red color of the dust from the low-manganese wires suggests the presence of iron oxide and the absence of manganese. The orange color suggests a mixture of iron and manganese in the arc vapor, which condenses as oxides. The color of the dust around a bare wire weld bead thus indicates in a qualitative way the composition of the wire.

★ ★ ★

COATING the 15CR wire produces a great change in welding characteristics on straight polarity. With either a sull or a mineral coating, the deposit rate is much slower than for the bare wire, as test results in Table Seven show. The coated electrodes are far easier to manipulate and the resulting welds have a better appearance than with bare wire. As the current was raised in small steps, slight porosity appeared on the surface of beads deposited by the sull coated electrodes at 230 amperes, straight polarity. The mineral coated electrode, in contrast, could be deposited without burnt appearance at 300 amperes, 20 volts, straight polarity. At this current the deposit rate is 3 seconds per inch.

★ ★ ★

IN this way the mineral coating has raised the speed at which good welds can be made.

★ ★ ★

THE results in Table Six show that carbon, silicon and manganese are lost to a very large extent in welding with bare and slightly coated electrodes. Sulfur is not lost.

★ ★ ★

Table Seven

Comparison of Deposit Rates of Bare and Lightly Coated Electrodes of Rimmed Steel 15CR.

	Amperes	Volts	Deposit Rate Sec/ Inch	Tendency to Globule Formation	Tendency to Burnt Welds
Straight Polarity					
Bare*	170	23	4.4	Slight	No
Sull Coated	200	20	7.0	No	No
Mineral Coated	200	20	7.0	No	No
Reverse Polarity					
Bare*	200	20	5.3	Yes	Slight
Sull Coated	190	24	5.5	Slight	Slight
Mineral Coated	190	26	5.7	Slight	Slight

* Rubbed with emery cloth before welding.

Wire for Submerged Arc Welding

THE two principal welding wires for submerged arc welding are listed in Table One. In addition to these, a wire containing 1% manganese is used to some extent, as well as a number of high-carbon and alloy steel wires for special purposes.

★ ★ ★

THE plain carbon wire in Table One is used with fluxes con-

(*Please turn to page 908*)

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The Role of Mill Service Men to Fabricators of Wire Products

By J. K. Findley, Met.

Alleghany Ludlum Steel Corp.

Dunkirk, N. Y.

Although the author's personal experiences have been principally devoted to the wire and wire products made from the stainless irons and steels, observations made over a number of years indicate that the subject matter is common to practically the entire wire and wire products industry. The paper presented before the Wire Association Convention October 23-26th, 1950 at Baltimore, Md.

THE wire producers' services to their customers—the fabricators of wire goods include many things such as keeping them informed on prices, deliveries, assisting in the proper selection of wires, also examining and adjusting any complaints that may arise.

★ ★ ★

THE purposes of these services of the wire producers is very evidently to increase the value of their sales, to lower wire production costs by the minimizing of rejections, and to help the wire products industry economically acquire their wire needs.

★ ★ ★

THE amount of personnel needed to administer these various services depends on the variety of purposes for which the wires are produced, the quantities involved, and the extent of the territories in which the wires are sold. A large producer of wires used for many purposes find it necessary to have well manned sales, sales engineering, research, metallurgical service, credit and claim departments, whereas a producer of wires for only one or two purposes, particularly one classified as a redrawer, may have only one or two men to cover the work of all the above mentioned departments.

★ ★ ★

AS far as most fabricators of wire products are concerned, the only representatives of the wire producers they see regularly are the salesmen. The next most frequently seen by the fabricators should be the men from the producing wire mills who are well acquainted with the production and qualities of their wires as well as the quality and manufacturing problems of the fabricator. It is the education and training of the last mentioned men that I would like to discuss in further detail.

★ ★ ★

THERE are reasons that it is more convenient to both the fabricators and the wire makers to have a minimum number of individuals from the wire producing mills calling on the users. One is that the wire salesmen, as well as the customers' purchasing agents and factory personnel, can minimize the time that might be wasted in unnecessary repetition of questions and statements regarding problems. Another is that the absence of some key men from the producing wire mill can cause production delays and errors. Also, the time consumed integrating the problems of the fabricators and their wire makers is less when the services are performed by men from the producing wire mills who specialize in such work.

★ ★ ★

ASSUMING, then, that it is advisable for the wire producers and their salesmen to have at their beck and call men from the wire mills who are acquainted with the fabricator-customer's problems and also that the number of men making these calls should be few as possible, let us consider the education and experiences that are best for such men. The nature and variety of the questions they must answer and the problems they must help solve should be the determining factors. Regardless of what the wire fabricators products are, the producers furnishing the wire will be confronted with questions and problems concerning at least two or more of the following; namely, correct temper in order to form to shape properly, physical properties such as strength in tension, compression or shear, ductility, work hardening characteristics, hardenability by heat treatment, machineability, condition of surface, size tolerances, electrical or magnetic characteristics, and/or chemical compositions best suited for their products. Some of these do not require scholastic learning in order to understand; however, others do, and for those men who are confronted with questions and problems in the average combination of factors mentioned above, the equivalent of a college of engineering education is practically a must. Further, they must learn to enlarge on their fundamental knowledge of chemistry, metallurgy, physics, etc., and apply those which will be involved in the manufacture of wires in the wire mills and in the servicing of these wires in their customers' fabricating shops.

★ ★ ★

INASMUCH as these men from the wire mills who call on cus-

(*Please turn to page* 911)

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The Oil-Filled Gas-Compression Cable

By Kenneth S. Wyatt, Cable Engineer
Phelps Dodge Copper Products Co.
New York, N. Y.

Introduction

RARELY in the course of engineering development has such a sharp transition been witnessed as recently in the field of underground power cables at extra-high voltage. The pre-war oil-filled cable in fiber-lined concrete duct banks has yielded almost completely in the post-war United States to the pipe cable—cable in steel pipe lines welded from end to end and filled with fluid under high pressure. Thus the common practice of installing low voltage wires and cables in iron conduit has, in a sense, been extended to the highest voltage range, namely, 66 kv. and above.

★ ★ ★

PRIOR to 1946 the oil-filled cable in this country totalled over 375 circuit miles in length, whereas the pipe cable amounted to only 14 miles. Since then, in a few short years, the pipe cable has grown rapidly until today the circuit miles in operation or under construction are over 264.

★ ★ ★

PIPE cables, of which there are several types, are simply three insulated conductors pulled simultaneously off three separate reels into a steel tube laid four feet underground, usually in half-mile lengths. The insulation is oil-impregnated paper, and is covered with a watertight sheath to protect the cable during shipment, installation and operation against ingress of moisture, air and other contaminants, and against the egress of the factory insulating oil. Sometimes the sheath is removed when pulled into the pipe, and sometimes a sheath of tightly wound tapes is resorted to. The steel pipe is equipped externally with a special anti-corrosion coating. Joints in the cable and pipe are made at intervals of ½ mile or more, and are usually housed in a permanent underground concrete vault or manhole. The pipe is filled with nitrogen or oil under 200 psi. Such cables are used for the transmission of large blocks of electric power under densely populated areas from the

KENNETH S. WYATT

Born in 1900 in Lyndhurst, England. Attended King's College School at Windsor, Nova Scotia. He took his undergraduate work at Mount Allison University, Sackville, New Brunswick, Canada, where he combined an engineering with a scientific training, taking honors in physics and chemistry. He continued his studies in the Harvard Graduate School. Later he was awarded a national Research Council of Canada Fellowship tenable at the University of Toronto, where he studied the supersaturation of gases in liquids at pressures of several hundred atmospheres.

His work was interrupted by many years of illness until 1928, when he joined the Research Department of The Detroit Edison Company, where he took a leading part for ten years in a large scale investigation of the deterioration of extra high voltage underground power cable. He was awarded the AIEE National Prize for Best Initial Paper in the year 1933, and again in 1938 the AIEE National Best Paper Prize in Theory and Research.

During this period he was very active in committee work, being a member for many years of the AIEE Research Committee, the AIEE Gold Medal Committee, the AEIC High Tension Cable Committee, the NELA Underground Systems Committee, Chairman of the Edison Research Coordinating Council Committee on Insulating Oils, Chairman of the Physics and Chemistry Division of the Insulation Committee of the National Research Council, Chairman of the Research Subcommittee of the AEIC High Tension Cable Committee, and others.

Besides his work on deterioration of electrical insulation, he also made a major contribution to oil-paper cables in the field of mechanical uniformity. After giving a series of lectures on this subject in London late in 1937, he became Technical Director in Charge of Engineering and Research of Enfield Cables, Ltd., where he immediately commenced active research and development of high pressure extra high voltage cables. Out of this came the Self-Contained Compression Cable of which there are now twenty-two installations in Great Britain and an experimental installation at 264 kv.

In the fall of 1940 he returned to the United States and joined the Phelps Dodge Copper Products Corporation as Engineer of Cables. He became interested in polyethylene radar cables in which his Company during the war became one of the leaders in production.

After the war he again concentrated on high pressure extra high voltage pipe cables, introducing the polyethylene sheath, and other modifications greatly simplifying earlier designs. Today his Company is the leader and in front in the pipe cable field at the highest voltages.

generating station to load-distribution centers or substations, and also from one load center to another. Fig. 1.

* * *

OF all the high pressure cables (i.e., 150 to 200 psi) contained in a steel pipe or in a reinforced lead sheath operating or under construction in this country or abroad, by far the greatest circuit mileage is in a type known as the Compression Cable. The number of installations is 55 and the combined length in excess of 150 miles. This type is not only the leader in point of mileage, it is the original steel pipe cable from which other types have sprung. The most economical form of this cable is the Oil-Filled Gas-Compression Cable. Its construction and basic principles will be the subject of this paper, which had its being in the thought that the notable growth in pipe cable would bear examination by this Association.

* * *

History

FROM the turn of the century the copper conductors of underground power cables have been chiefly insulated with oil-impregnated paper applied in tape form. This has been because of the excellent dielectric properties of this material, and the way in which it meets the exacting cable requirement of flexibility, both hand-in-hand with low cost. When voltages of over 20 kv. were reached, however, electrical failures were frequent and widespread. After much research it was discovered that these were due to corona discharge in vacuous interlayer spaces, and these in turn were caused by the excessive expansion of the oil impregnant, which because of its unusually high coefficient of expansion, caused a permanent stretching of the paper insulation and the lead sheath when the conductor became hot due to loading. The solution was to maintain the oil in the insulation under pressure

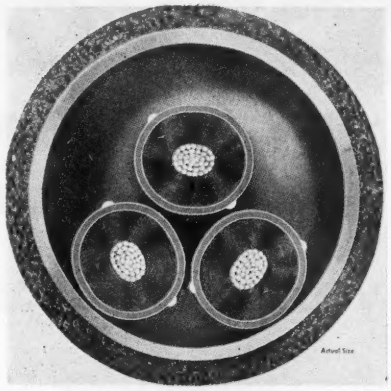

Fig. 1—138,000 volt Compression Cable on Long Island, N. Y., Valley Stream to Jamaica—350,000 CM oval conductor. * * * * * *

so that even under the most rapid and severe drop in load no gaseous spaces (films) could form due to contraction of the oil. When gas spaces were completely eliminated, the long-time dielectric strength increased more than three-fold, and the electrical properties of the insulation became changeless with time, i.e., deterioration and aging vanished. This finding, which was arrived at over a long period of years, opened up the possibility that if a satisfactory way of maintaining the cable insulating oil under pressure could be devised, its cost could be offset by reducing the thickness of insulation wall by half or even less. It also opened up the possibility of safe operation at much higher voltages.

* * *

THE problem was solved by two men, each in his own way, but both by applying the principle of keeping the oil in the insulation wall under pressure at all times even during the cable's most rapid and severe cooling cycle. Both of these men are now recognized as the outstanding geniuses in the EHV cable field. One is **Luigi Emanuelli,** who is the Father of the low-pressure Pirelli Oil-Filled type of cable. The other is **Martin Hochstadter,** who is the Father of High-Pressure Pipe cable and high pressure modifications of the same. Hockstadter before this had made possible another great forward stride in the cable-making art through his introduction of the grounded metal screen over each insulated core, generally known in most countries as the "H" type cable. The "H" type principle is employed in all EHV cables, including those of Emanuelli. From these two men have come most of the extra-high voltage cable designs of today, but many illustrious names are associated with their development.

* * *

EMANUELLI'S solution to the problem of maintaining the oil in the insulation at all times under pressure was **to feed oil into the insulation** through longitudinal channels in the conductor at intervals of 500 or 1000 feet. He contained the oil in a **metal membrane,** and was actuated (usually) by means of low pressure **nitrogen gas.** By using a very low viscosity oil and by a high degree of degassing of the insulation, he found he required only 5 to 10 psi pressure. In 1926 his design of cable was installed in New York and Chicago at the then unprecedented voltage of 138,000. From 1926 to 1946 it found widespread application throughout the principal countries of the world.

* * *

HOCHSTADTER did not commence his experiments until 1926. He solved the problem of maintaining the oil in the insulation wall at positive pressure, not by feeding in oil, but by making the cable out-of-round in cross section, and then compressing it by means of an external fluid medium, the pressure medium being separated from the insulation by a continuous (extruded) sheath. In practice, either an oval or triangular cross-section was used. The pressure in the oil in the insulation was the external pressure less the pressure drop across the sheath due to its rigidity. When the oil in the insulation expanded, the flat sides of the oval or triangle would bulge outward, and when it contracted, the external pressure forced the sheath back. Thus the sheath underwent, in opera-

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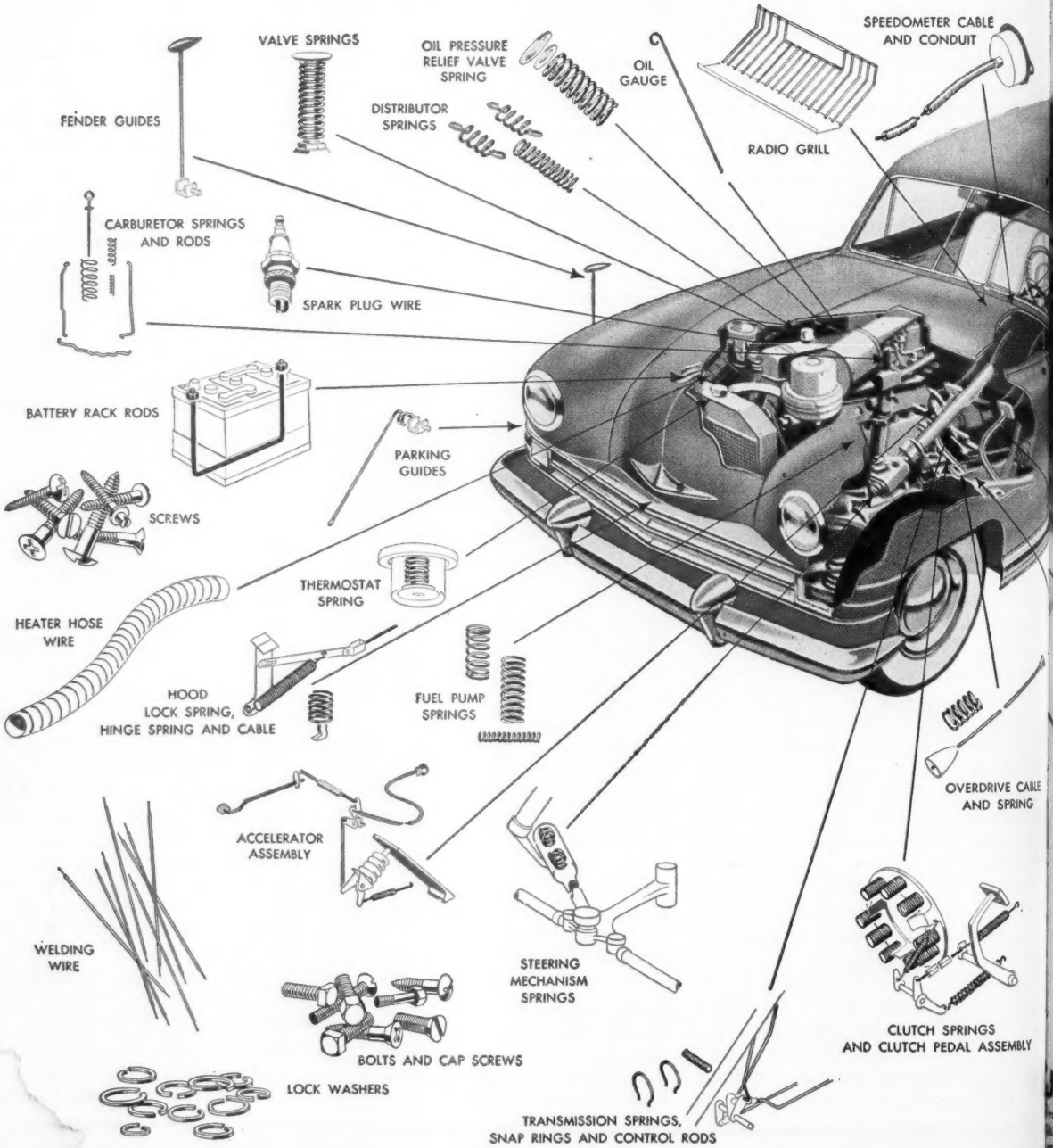

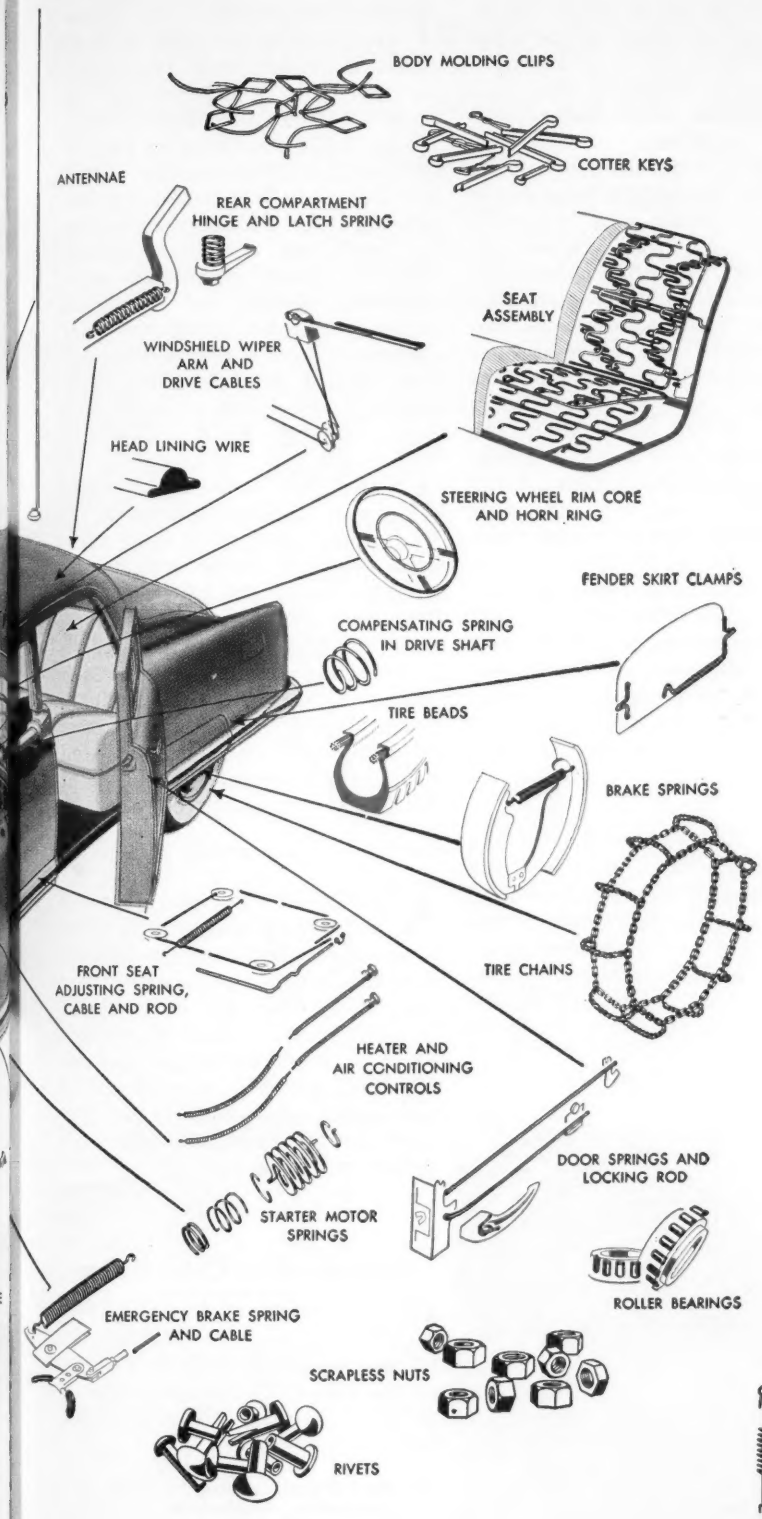

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tion, a "breathing" action, the stroke, however, being only a few mils. The sheath is a **membrane actuated by high pressure nitrogen gas** causing the oil in the cable to flow in a radial direction. Thus, both men employed the same general means to solve the problem, namely, a **membrane actuated by external gas pressure.** Emanuelli had to feed oil into the cable from outside in a longitudinal direction. Hochstadter used the sheath as a "distributed" membrane, and the cable was a sealed unit which did not need outside oil. Whereas Emanuelli dried, degassed and impregnated his cable inside the sheath, thereby attaining a high degree of degasification, Hochstadter's cable was mass-impregnated as a solid cable, and then sheathed, and the degassing was not so thorough. Hochstadter had to use higher pressures because of a drop across the lead sheath of 30 to 40 psi and because of the springiness of the insulation in resisting pressure. A high pressure container of low cost was necessary and the steel pipe was the answer. The first EHV steel pipe cable was installed in London in 1931 at 69 kv. The pressure employed was 200 psi. Most pipe cables since then have adopted this nominal pressure. In later installations oil was sometimes used as the compression medium in place of gas.

* * *

IN subsequent years a modification was evolved by Hugo Sonnenfeld, who dispensed with the sheath, thus bringing the pressure medium, gas or oil, into direct contact with the insulation. The oil modification has been tried in the United States and has attained a considerable vogue, since omitting the sheath represents a small economy, albeit at the risk of some contamination and consequently a possible slight reduction in the safety factor. The gas modification has also found application, but as oil may drain out of the insulation, free gas spaces must inevitably form, and in these corona discharge may occur under switching or other surge conditions. In such a cable the principle of Emanuelli and Hochstadter of maintaining the oil in the insulation wall under pressure to eliminate corona discharge and to obtain thereby the more than three-fold increase in long-time breakdown strength has been forgotten. Hence, although all the expense involved in the use of high pressure, e.g., steel pipe, special terminals, and accessories is still necessary for the gas-filled insulation cable, the long-time breakdown strength at 225 psi is about the same as that of a solid cable, i.e., about one-third that of the same cable where the insulation is kept filled with oil under positive pressure under the Emanuelli or Hochstadter Systems. Pipe cables such as these with free gas in the insulation, equipped with a generous wall of insulation, have however given good service at 120 kv. But their value at 200 kv. or above is open to question.

* * *

ANOTHER modification of the Compression Cable was the substitution of a reinforced lead sheath for the steel pipe as the gas container. This design is called the Self-Contained Compression Cable and over 20 installations have been made in England.

* * *

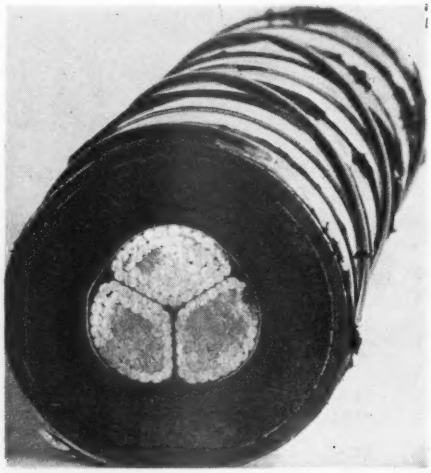


Fig. 2—138,000 volt Compression Cable in New York—Hell Gate to Jamaica—1,500,000 CM triangular conductor.

THE Compression Cable, as developed in America, is very much simplified and less costly design than that used abroad. Instead of 700 foot lengths between joints, 3,400 foot lengths are being used in this country. This has been made possible by dispensing with unnecessary armor, by replacing the lead sheath with a bronze reinforced polyethylene sheath of negligible weight, and by using specially designed skid wires in conjunction with a pre-lubricated pipe. Fig. 2.

* * *

AS the pipe cable has become more highly developed, so has the oil-filled cable. High pressure oil-filled cable was developed by **Borell** and by **Domenach.** This necessitated reinforced lead sheath which made the design uneconomic at 138 kv. Domenach has employed ultra-thin papers in conjunction with high pressure oil-filled cable and has succeeded in making a commercial cable at 400 kv. for use in Sweden.

* * *

ALTHOUGH the development and production of pipe cable is now proceeding at a relatively feverish pace, the historic fact that Daniel Brooks, in England, actually made a steel pipe cable filled with oil under pressure as far back as 1875, should not be lost sight of. The cable was however for communication, not power, purposes.

* * *

The Basis of the Cable Design

IN the design of the Oil-Filled Gas-Compression Cable, the ultimate goal was the fulfillment of the following requirements for the cable and associated duct system.

(1) **Mechanically strong to resist earth movements, explosions, excavation tools, traffic vibration.**

(2) **Electrically strong, a high factor of safety with respect to long-time breakdown, permanence of this factor of safety over 30 years, a minimum number of weak spots, such as hand-made field joints.**

FIRTHALOY DRAWING DIES

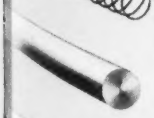
FOR WIRE, BAR AND TUBE DRAWING

Better *Faster* *Cheaper*

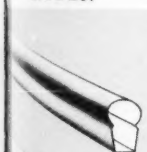
Advanced design in carbide nib proportions, cored back relief and sturdy casing construction assures maximum usability and correct drawing contours through the life of the dies.

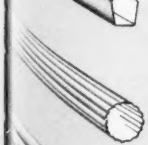
Preformed back relief minimizes finishing and recut time. Tougher Firthaloy carbide and its superior resistance to wear means greater production with minimum downtime.

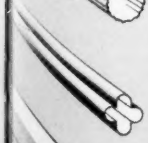
More and better carbide for your money in the new Super-Standard Firthaloy Round Dies means greater usefulness of the dies — fewer dies needed for the job.

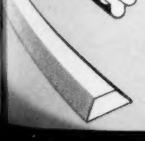


AVAILABLE IN STANDARD, ROUND, SQUARE AND HEX DIES OR NIBS AND ALL SPECIAL SHAPES.

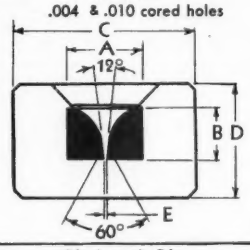




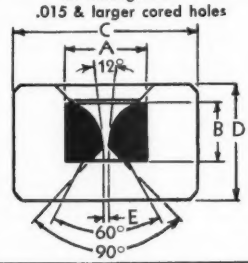




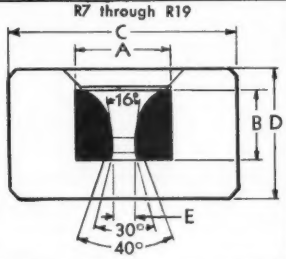
R1 & R2
.004 & .010 cored holes



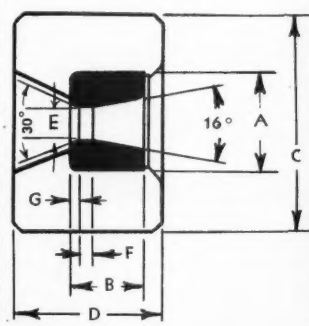
R1 through R6
.015 & larger cored holes



R7 through R19



Contour Sketch
Hexagon & Square



Die Number	Std. Nib Sizes Diameter A	Std. Nib Sizes Height B	Maximum Rec. Hole Sizes	Std Casing Sizes Diameter C	Std Casing Sizes Height D	Standard Rough Cored Hole Sizes E
R-1	.325	.240	.106	1	½	.004, .010, .015, .025
R-2	.325	.330	.128	1 1½ 1¼ 1½	¾ ¾ ¾ ¾	.004, .010, .015, .025, .040
R-3	.450	.380	.182	1¼ 1½	¾ ¾	.015, .025, .040, .055
R-4	.500	.450	.230	1¼ 1½	⅜ ⅜	.015, .025, .040, .055, .085
R-5	.625	.600	.280	1½	⅜	.025, .040, .055, .085, .120
R-6	.710	.700	.350	2	1¼	.040, .055, .085, .120, .150, .200
R-7	.768	.768	.425	3	1¾	.230, .290, .350
R-8	1.000	.820	.516	3	1¾	.230, .290, .350, .420
R-9	1.187	.820	.687	3	1¾	.350, .420, .480, .545, .605
R-10	1.500	1.000	.875	3 4	2 2	.480, .545, .605, .670, .725
R-11	1.830	1.250	1.250	4	2¼	.725, .850, .975, 1.100
R-12	2.185	1.375	1.500	4	2¾	.975, 1.100, 1.225, 1.350
R-14	2.560	1.375	1.750	6 7	2½ 2½	1.225, 1.350, 1.475, 1.600
R-15	3.000	1.375	2.250	7	2½	1.475, 1.600, 1.725, 1.975
R-16	3.500	1.375	2.500	7	2½	1.975, 2.100, 2.225, 2.350
R-17	4.000	1.500	3.000	9	3	2.225, 2.475, 2.725
R-18	5.500	2.125	3.750	11	4½	AVAILABLE ONLY IN ROUGH DRILLED OR FINISHED FORM
R-19	6.500	2.125	4.500	13	4½	

TOLERANCES FOR ROUGH CORED HOLES
Sizes R-1 thru R-17

HOLE SIZE	TOL.
.004	— .001
.010	— .003
.015 to .040	— .005
.065 to .090	— .008
.100 to .200	— .010
.201 to .480	— .020
.481 to .730	— .025
.731 to 1.000	— .030
1.001 to 1.300	— .035
1.301 to 1.600	— .040
1.601 to 2.000	— .045
2.001 to 3.000	— .060
3.001 and up	— .080

TOLERANCES FOR ROUGH DRILLED HOLES
Sizes R-1 thru R-19

Hole Sizes 1" and under	— .005
Hole Sizes over 1"	— .010

TOLERANCES FOR FINISHED HOLES
Sizes R-1 thru R-19
PLUG GAGE DIMENSION

Under .020	— .0002
.020 thru .125	— .0005
.126 and over	— .001

TOLERANCES OF CASINGS
Sizes R-1 thru R-19

CASING SIZE	TOLERANCE DIA.	TOLERANCE HT.
2" dia. or less	+.000 —.015	+.015 —.015
Over 2" dia.	+.000 —.030	+.015 —.015

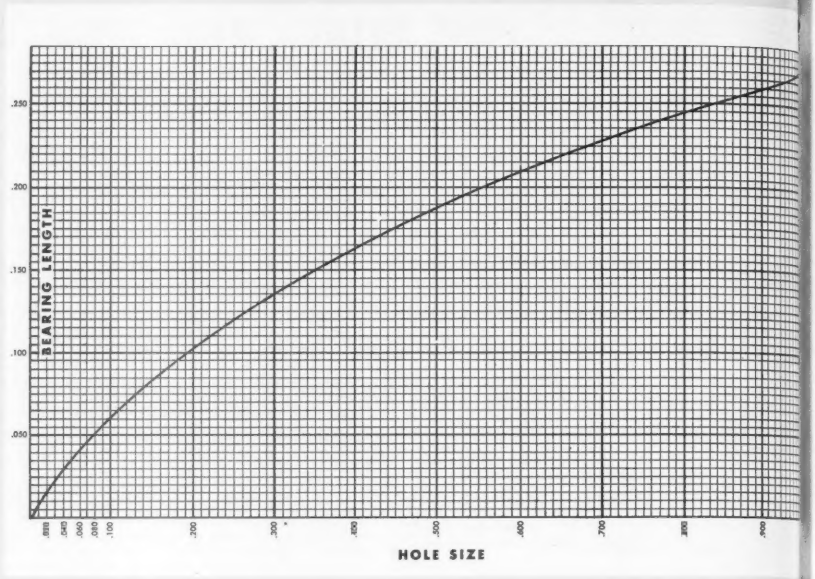
STANDARD SQUARE & HEXAGON

DIE No.	STD. NIB DIA. "A"	STD. NIB HT. "B"	STD. CASE DIA. "C"	STD. CASE HT. "D"	OTHER DIMENSIONS "F"	OTHER DIMENSIONS "G"	STANDARD ROUGH CORED HOLE SIZES "E" HEX.	STANDARD ROUGH CORED HOLE SIZES "E" SQUARE	TOLERANCES RC	TOLERANCES RD	TOLERANCES FIN.
R- 4	.550	.400	1½	¾	⅛	3/64	⅛-3/16	5/32			
R- 5	.675	.575	1½	⅞	5/32	1/16	7/32-¼	3/16	— .005 TO — .012		
R- 6	.770	.670	2	1⅛	7/32	3/32	9/32-5/16	7/32-¼			
R- 7	.850	.750	3	1⅜	7/32	3/32		9/32			
R- 8	1.000	.820	3	1¾	¼	⅛	11/32-½	5/16-⅜			
R- 9	1.187	.850	3	1¾	¼	⅛	9/16-⅝	7/16-½			
R-10	1.500	1.000	4	2	5/16	⅛	11/16-13/16	9/16-⅝ 11/16	— .005 TO — .017	— .004 TO — .007	+ .000 TO — .001
R-11	1.830	1.250	4	2¼	11/32	3/16	⅞-1	¾-13/16			
R-12	2.185	1.375	4	2⅜	11/32	3/16	1 1/16-1¼	⅞-15/16 1			
R-14	2.560	1.375	6 7	2½ 2½	11/32	3/16	1 5/16-1⅜ 1½	1 1/16-1⅛ 1 3/16-1¼	— .010 — .035		
R-15	3.000	1.375	7	2¾	⅜	3/16	1 5/16-1¾ 1⅞	1 5/16-1⅜ 1½	— .010 — .040		
R-16	3.500	1.375	7	2¾	⅜	3/16		1⅝	— .010 — .045		

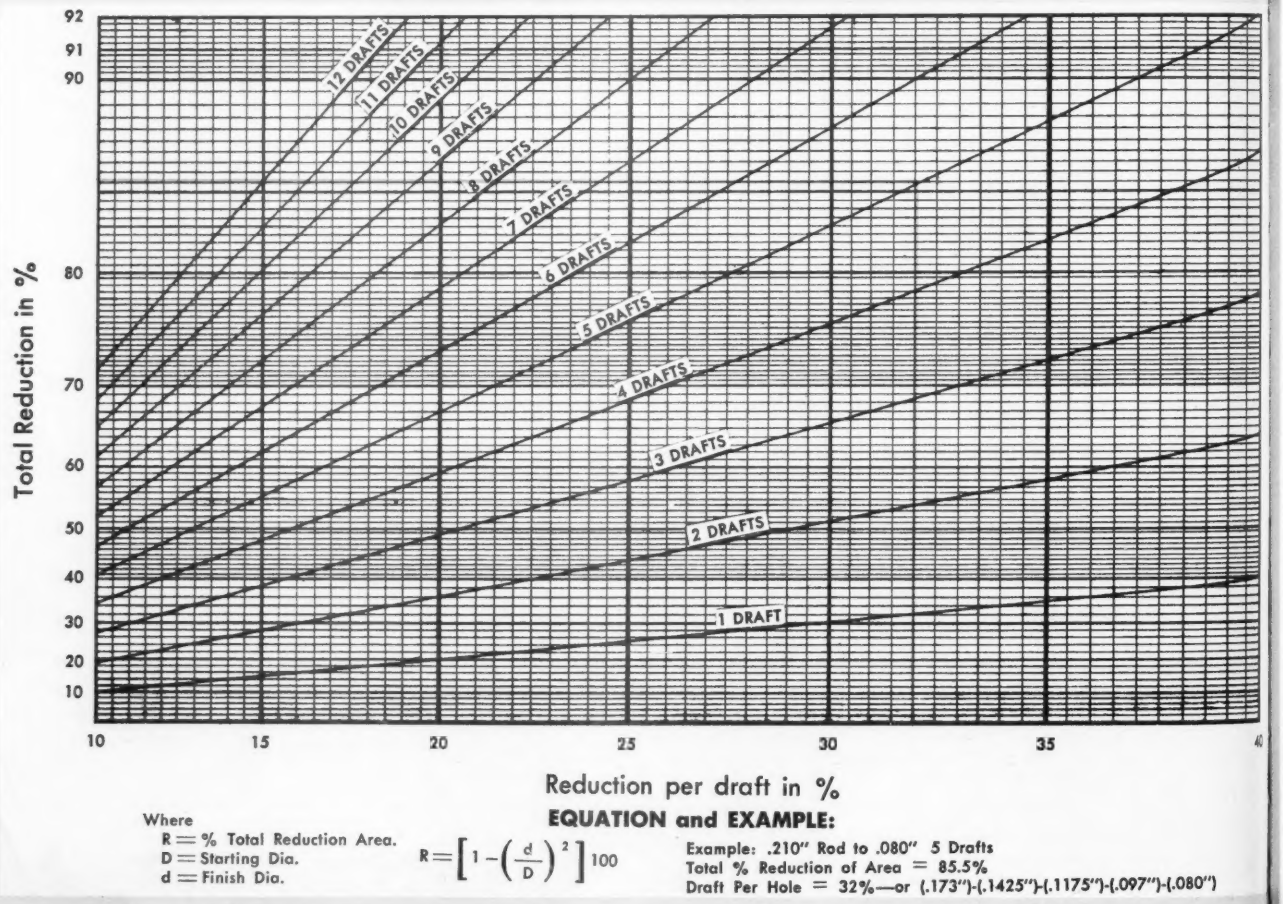
Firth-Sterling
STEEL & CARBIDE CORPORATION
OFFICES: Pittsburgh, Pa. New York Hartford Cleveland
Dayton Philadelphia Detroit Chicago Los Angeles

TABLE FOR DETERMINING MEETING POINT WITH STANDARD BACK RELIEF		
Included Entrance Angle	Multiply bearing length desired by factor in column applying to proper back relief. Subtract this product from the finished hole diameter.	
	Back Relief	
	90° Inc.	30° Inc.
8°	.1307	.111
10°	.1608	.132
12°	.190	.151
14°	.2185	.169
16°	.246	.184
18°	.274	.199
20°	.300	.212
22°	.326	.225
24°	.350	.237
26°	.375	.248
28°	.399	.258
30°	.422	.268

BEARING LENGTH CHART



WIRE DRAFTING CHART



Where
R = % Total Reduction Area.
D = Starting Dia.
d = Finish Dia.

$$R = \left[1 - \left(\frac{d}{D}\right)^2\right] 100$$

EQUATION and EXAMPLE:

Example: .210" Rod to .080" 5 Drafts
Total % Reduction of Area = 85.5%
Draft Per Hole = 32%—or (.173")-(.1425")-(.1175")-(.097")-(.080")

Firth-Sterling STEEL & CARBIDE CORPORATIO

OFFICES: PITTSBURGH, PA. NEW YORK HARTFORD CLEVELA

(3) Thermally good so as to dissipate heat and obtain the greatest current carrying capacity for a given conductor size.
(4) Installation must take a minimum of labor and time.
(5) Maintenance should be negligible.
(6) Repairs should be easy and quick, accessibility to joints and terminals should be good, system must permit the quick installation of a spare length; and
(7) Finally the overall installed cost must be low.

★ ★ ★

IN the Oil-Filled Gas-Compression cable the first requirement of mechanical strength is more than met by the steel pipe; electrical strength is more than adequate due to the insulation being filled with oil under pressure, and electrical weak spots (hand-made field joints) are reduced to a minimum by the possibility of pulling exceptionally long lengths as a result of special skid wire design and pre-lubrication of the pipe; the current carrying capacity is approximately as good as can be obtained in a steel pipe cable as there are no gas films in the insulation to give a high thermal resistance; maintenance is negligible as there are no appreciable pressure changes, no pumps to get out of order; repairs are easy, a spare length of cable can be pulled into the pipe between manholes in short order; and the overall installed cost is the lowest of any cable system with oil-filled insulation. Let us examine the chief points of the design more carefully.

★ ★ ★

Why Keep the Insulation Filled with Oil?

OIL-FILLING of the insulation under pressure gives the highest long-time dielectric strength and stability inherent in the materials. It does this by preventing the formation of interlayer gas films in which corona discharge may take place slowly weakening the insulation. Although the short-time dielectric strength of nitrogen gas films of different thicknesses under 200 or 225 psi, as measured in the laboratory, may show high values, the results of such "pop" tests, when applied to high voltage cable, are extremely misleading. The most significant charactertistic of a high voltage cable of the oil-paper type, particularly if obtained on cable before and after accelerated load-cycle tests, is the curve of life or time-to-breakdown versus voltage. Typical curves for the oil-filled types of cable, for the solid cable and for the high pressure gas-filled cable are shown in Fig. 3. It will be observed at first glance that the short time values for the different cables are of the same order, but the long-time values show a marked divergence. The high pressure oil-filled insulation has a long-time breakdown value of 1200 V/mil or over, the low pressure oil-filled cable 1000 V/mil, the solid cable and the high pressure gas-filled cable (225 psi) 300 to 350 V/mil at the conductor. These values, when compared with operating stresses, show a factor of safety for the higher pressure oil-filled types of over 4, and for the gas-filled type of only about 1½, where the insulation thickness employed for all types is the same. Some engineers feel that a safety factor of 1½ is adequate even though switching surges are 3 to 4 times operating voltage because such surges are of short duration. However, since no extra materials are required to keep the insulation filled with oil and thus to raise the safety factor from 1½ to over 4 times operating voltage, the oil-filled insulation was the only type considered.

★ ★ ★

GAS films in the interlayer space raise the thermal resistivity of the cable insulation and reduce its current carrying capacity. The average measured value of resistivity of oil-filled cable insulation known to the author is 430 thermal ohms, and for gas-filled insulation over 700 thermal ohms.

★ ★ ★

Why Jacket the Cable in a Continuous Sheath?

DURING shipment of the cable there is considerable variation in temperature causing the oil to expand out of the insulation in the day and to contract and draw in moist air at night. In the operation of a cable without a continu-

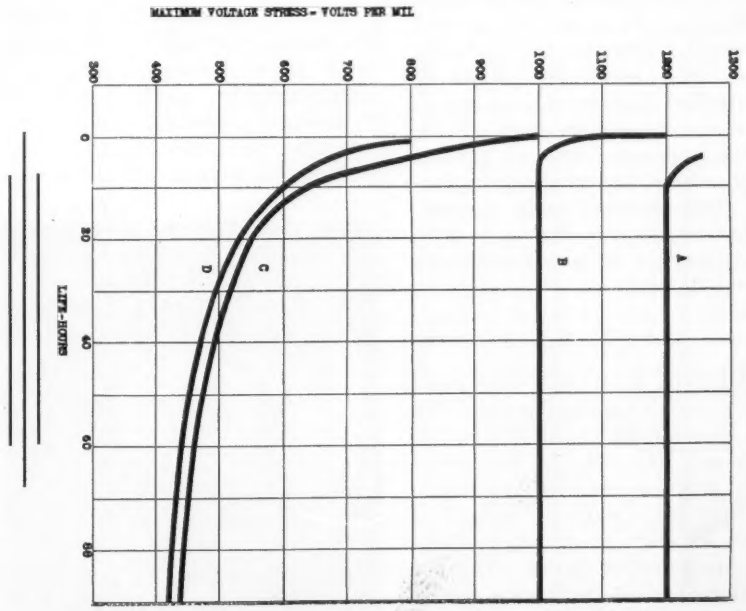


Fig. 3—Life vs. voltage curves for High and Low Pressure Oil-Filled cable compared with those for Solid and Gas-Filled Cable.

A—Life curve for cable insulation filled with oil under high pressure.
B—Life curve for cable insulation filled with oil under low pressure.
C—Life curve for cable insulation of the solid type.
D—Life curve for cable insulation filled with gas at 225 psi.

ous sheath in a gas-filled pipe the heating and cooling will cause the oil to leave the insulation, especially on slopes. Or where the cable at a stop joint passes through a stuffing box or "squeeze-type" gland, the oil will drip out of the insulation, lowering appreciably the dielectric strength of the cable. Contamination of the insulation by oxidation and moisture, and the replacement of oil with gas films, are highly undesirable for reasons already given.

★ ★ ★

IT is diffcult, too, to take an unsheathed cable up into an oil-filled terminal, as whatever stop gland may be used, there will be the likelihood of the oil in the pothead leaking through the insulation and out into the gas-filled pipe. In effect, the use of an unsheathed cable in a gas-filled pipe requires the use of the gas-filled terminal, which is undesirable for reasons to be given later.

★ ★ ★

EXPERIENCE has shown that where the factory "atmosphere," that is, the high degree of drying, degassing and impregnation attained under controlled conditions in the factory, can be maintained, there is a perfect operating record. Troubles occur chiefly where hand workmanship under uncontrolled field conditions, as at joints, has been necessary. There is only one sure way to permanently ensure that the original factory "atmosphere" will permanently prevail, and that is to provide the cable with a continuous (extruded) sheath.

★ ★ ★

THERE is, then, only one positive way of ensuring that the cable throughout shipment, installation and life shall be preserved in its original pristine condition, and that is to extrude onto it a sheath as soon as it comes from the impregnating tanks. The cable from then on becomes a sealed unit, no longer at the mercy of human carelessness.

★ ★ ★

Why Use an Oval or Triangular Shape?

THE first two steps in design, namely, filling the insulation completely with oil and jacketing it with a continuous sheath, have been decided on. But owing to the high expansion coefficient of the oil relative to the other components, a sheath of circular cross-section would burst due to the oil pressure when the cable was heavily loaded. Some method of compensating for the differential expansion of the oil has to be devised since the only known method in commercial use, the Emanuelli longitudinal oil feed, leads to expensive complications. The solution is to make the cable oval, the differential expansion is then in part accommodated by change of shape from oval toward circular. (Part of the expansion is taken care of by the 1 per cent compressibility of oil-paper insulation at 200 psi.) The "breathing" of the sheath has been measured for various cable sizes and is very limited in amount.

★ ★ ★

A CIRCULAR shell, when subjected to external pressure, does not collapse symmetrically. Instead, it crumples. Because even the most thoroughly oil-impregnated paper insulation has some compressibility (about 1 per cent at 200 psi) probably owing to microscopic air cells in the paper fiber, when a round cable is subjected to external pressure it wrinkles and folds (Fig. 4). When such a cable is pulled out of a pipe, flats will be observed running along the cable for a few feet, then starting at another place on the periphery. Inside the cable at these places, large voids, sometimes 50 mils in thickness, have been formed. Even if these are filled with oil, this severe crumpling of the layer structure must reduce the factor of safety somewhat. [3] By making the cross-section oval in shape, the insulation can breathe symmetrically in response to external pressure.

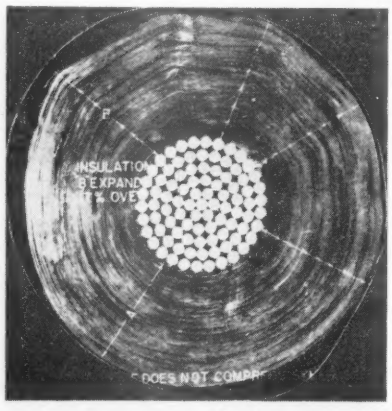


Fig. 4—Wafer photograph of cable cross-section after subjection to 200 psi. Weight of conductor maintained lower half of insulation free from wrinkles. Crumpling caused formation of voids along radical spokes.

★ ★ ★

Why Is the Sheath Metal-Reinforced?

THE expansion of the oil in the cable would cause the sheath to stretch, and on the cooling cycle the pressure would cause the loose portion to fold over and crack. At the bottom of long vertical risers up to 120 feet in height, the hydraulic head will attain 45 psi. For both reasons it is desirable to reinforce the sheath with two 5-mil high tensile bronze tapes applied 50 per cent break-gap, so as to give the sheath an internal rupture strength of between 500 and 600 psi. These bronze tapes serve the further purpose of preventing any tendency of the polyethylene to swell at emergency temperatures.

★ ★ ★

Why Use Long Lay Skid Wires?

THE original pipe cable in 1931 used a ¼" steel strip with 3½" lay as a skid. In the Long Island cable 3 D-shaped copper skid wires were used with a 12" lay to give a spacing between adjacent wires of 4". This long lay definitely reduced the coefficient of friction and paved the way for longer pulling lengths. The use of short-lay (1-¼" between turns) skid wires is poor practice because being almost at right angles to the direction of pull, the wires tend to turn over and indent the shielding tape and insulation, in addition to raising the friction coefficient.

★ ★ ★

THE skid wire consideration is important because analysis of EHV cable failures in this country and abroad shows that the failures occur almost exclusively at joints (recently in this country at terminals in one design). If handwork under field conditions can be partly eliminated a far more reliable cable system results at appreciably less money. A pipe cable joint and manhole in our largest cities cost about $10,000. There is thus every reason for our having put special effort on this aspect of the problem, since it is of great importance to the utilities.

* * *

THREE developments in connection with the Oil-Filled Gas-Compression Cable make it possible to pull long lengths without risk. These are first, the use of 3 skid wires with 12″ lay, first employed on the Long Island cable; the use of a brass instead of copper skid, first employed on the Hell Gate cable; and third, thorough pre-lubrication of the pipe, first practiced on the Milwaukee cable. Brass very materially reduces the coefficient of friction, and at the same time, owing to its high resistivity, reduces whatever electrical losses there may be in them to negligible values. Pre-lubrication is accomplished by pulling through the pipe a caterpillar consisting of a series of swabs, Fig. 5, the first of which force the oil over the whole inside surface of the pipe, and the last of which wipe the pipe free from excess oil. With these innovations the friction coefficient on straight pulls sometimes runs below 0.20, as at Philadelphia. In Mexico City and in Columbus, Ohio, it is planned to pull 3,400 foot lengths on the straight runs. The author believes that the next year or two will witness 4,000 foot pulls in pipe cable as a routine matter.

* * *

IN special cases, such as underwater river crossings, pulls of 6,000 to 7,000 feet are practicable without special reinforcement by the use of long lay brass skid wires, together with the simple expedient of putting enough oil in the pipe so that when the cable is pulled in, the pipe is full of oil. In this way about one-third of the weight of the cable disappears and the friction coefficient drops due to the 100 per cent lubrication.

* * *

Why Gas as the Compression Medium?

EITHER nitrogen or oil can be used as the compression medium. Gas is preferred because the pressure is uniform from end to end of the line regardless of the profile of the route, or of sudden changes in loading, or of short-circuit conditions. It is preferred because it makes for simplicity in system arrangement, in filling and in maintenance. 100,000 cu. ft. of gas can be charged into a pipe in 3 or 4 hours from a liquid nitrogen truck. A valve is provided at either end where a nitrogen bottle can be coupled on and fresh gas introduced if there is a slight drop in pressure during the year. Today the perfection of steel pipe, the perfection of welding, and the thoroughness in testing ensure complete gas tightness of the pipe from end to end. Today there is no excuse whatever for leaky valves or fittings in the terminal structure or in the joint by-passes. Complete assurance can be given against leakage of gas. Finally, the gas medium is appreciably cheaper than the oil medium in first cost.

* * *

OIL may be used as the compression medium but has the disadvantage of serious pressure differentials along the line due to sudden changes in loading of the cable as the oil has to expand back from the dead end of the line to the expansion reservoir at the other end; also, pressure differentials due to hydraulic head in hilly country; and pressure differentials of 10,000 or 15,000 psi under short circuit conditions. Oil requires a pumping plant and expansion reservoir which depends on electric power supply. The pumping plant requires a building to house it and a heater to maintain the temperature at 60° F. or above. These things mean increased first-cost and increased maintenance. The cost of the oil required to fill the pipe is a considerable item. The oil has to be cleaned and degassed as it is introduced into the line, and this takes 3 to 4 days, where gas would take 3 to 4 hours.

* * *

WITH oil-filling, there is a tendency to use a smaller size pipe because of the considerable saving in the cost of the oil. The result is there is not enough room for the cable to snake in the pipe and so absorb the considerable expansion thrust forces of the conductors when heavily loaded. It is not generally realized that oil-filling of the pipe contributes materially to the transfer of these thrust forces to the joints. In an oil medium, the cable may lose one-third of its weight, and because of 100 per cent lubrication, the friction coefficient may drop to low values. The friction, due to the weight of the cable on the bottom of the pipe, which normally serves to anchor a large proportion of the cable length between joints, is now greatly reduced, and accordingly conductor expansion forces are free to act in greater measure on the joints. There is no doubt that

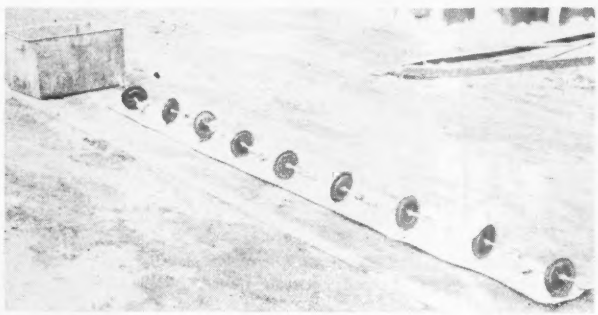
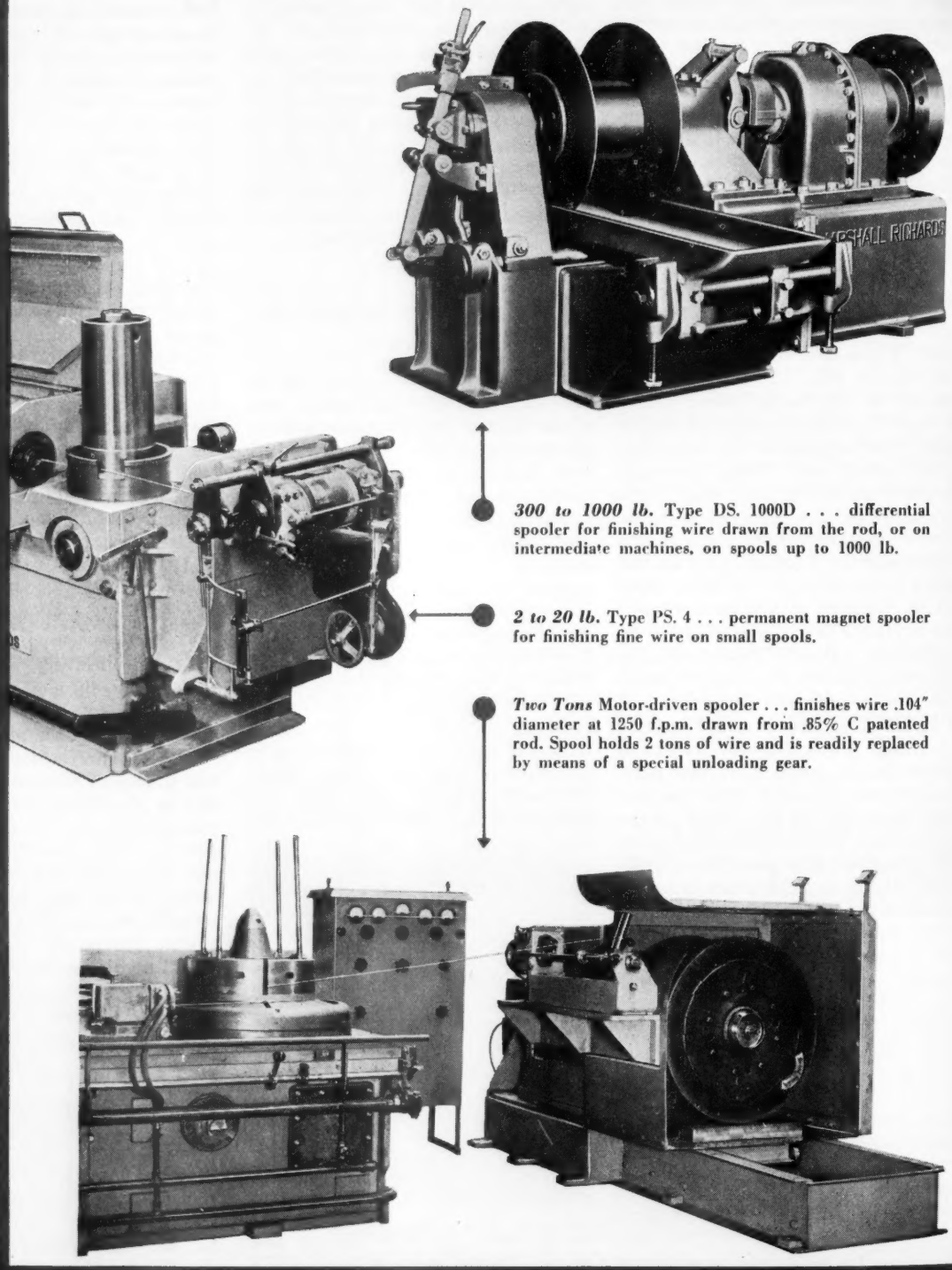


Fig. 5—Caterpillar for pre-lubricating the pipe. The first swabs push the oil through the pipe, the last act as wipers to remove excess oil.

How to cut costs.....wit Ma



300 to 1000 lb. Type DS. 1000D . . . differential spooler for finishing wire drawn from the rod, or on intermediate machines, on spools up to 1000 lb.

2 to 20 lb. Type PS. 4 . . . permanent magnet spooler for finishing fine wire on small spools.

Two Tons Motor-driven spooler . . . finishes wire .104" diameter at 1250 f.p.m. drawn from .85% C patented rod. Spool holds 2 tons of wire and is readily replaced by means of a special unloading gear.

Marshall Richards spoolers!

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FINISH STEEL WIRE on Marshall Richards Spoolers and you'll win four ways. *First,* you'll get a lot greater machine efficiency because heavier weights can be finished on a spool . . . standing time for stripping blocks is greatly reduced. *Next,* you'll slash processing costs. Spools with up to two tons of continuous wire can feed any sort of processing equipment without attention.

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the use of a larger pipe reduces these forces appreciably. With gas the increase in cost is roughly proportional to the diameter of the pipes, but with an oil medium there is not only the increased cost of the pipe to consider, but, more particularly, the cost of the additional oil and pumping plant. The writer believes that conductor expansion forces in pipe cable should receive very careful consideration; when joints fail due to this agency, the cause will probably never be known.

* * *

ONE advantage of the oil medium urged by its advocates is that by freezing the oil with liquid air or a carbon dioxide snow bath, the pipe may quickly be sectionalized in case of trouble. With the large volume of oil in the pipe there certainly may be need of sectionalization in a crowded city. This seems to be a thin basis for making a decision that a whole system shall be oil instead of gas. Nitrogen gas is cheap; should pressure be lost, it can quickly be replaced; it is inert and does not represent a fire hazard. The Oil-Filled Gas-Compression Cable may be operated 24 hours without pressure.

* * *

IT will be seen that the gas medium because of its cheapness makes more probable the choice of adequate diameter, so that thrust forces, due to conductor expansion, are minimized. The friction anchorage of the cable to the pipe is not sharply reduced as with oil, and so the thrust force problem at joints is not further aggravated.

* * *

Why an Oil-Filled Terminal?

OIL has high dielectric strength and makes the ideal insulation for EHV high pressure terminals where transients from overhead lines or from lightning are constantly encountered. The oil terminal operates perfectly satisfactorily without pressure. In terminal designs where the porcelain is permitted to carry the 200 psi pressure, there is no danger to personnel if the porcelain fractures, since oil does not expand when pressure is relieved. However, in the 19 years since the first installation nearly 300 such oil-filled terminals, with the porcelain carrying the pressure, have been put in service. To the writer's knowledge these have given perfect trouble-free service excepting for some temporary gasket leakage on the 1931 installation.

* * *

IF the cable had not been jacketed with a tight sheath, a gas-filled terminal would have been mandatory because the oil filling would have seeped into the gas-filled pipe through the insulation. In the gas terminal the line must quickly be taken out of service when gas pressure is lost because if the pressure drops from 200 to 60 psi, internal flashover will occur. In a gas terminal tracking or a stewing arc over the built-up oil-paper insulation has occurred more than once abroad, finally resulting in a high energy arc and the explosion with fire of the pothead over a considerable distance. If the porcelain carries the gas pressure, breakage of the pothead would be attended with considerable danger to personnel.

* * *

ONCE a cable design with a continuous sheath had been developed, there was no need for our adopting the less reliable and more hazardous gas-filled terminal, and the simplest type of oil-filled terminal, viz., that in which the porcelain carries the full pressure, was the obvious choice for the reasons given and because of the satisfactory service of nearly 300 of these abroad over periods up to 19 years.

* * *

The Finalized Design

THE series of logical and positive steps outlined above culminate in the present design of the Oil-Filled Gas-Compression Cable. Oil-filling under pressure in the cable insulation and terminals where electric stress occurs to obtain the highest possible factor of safety against breakdown; a metal reinforced continuous sheath rendering the cable a sealed unit throughout shipment, installation and operating life with the factory atmosphere maintained within, free from contamination and deterioration of any kind; an oval or triangular form to compensate for oil-expansion and to permit the insulation to respond symmetrically to external pressure; and gas in the pipe as the pressure medium for utmost simplicity and economy: These all combine to give a cable system proof against a great variety of hazards and of low overall installed cost.

* * *

The System

THE system, of which the cable is only a part, consists also of a coated steel pipe line with joints and manholes, and terminations including spreaderheads, riser tubes, potheads and supporting structure, accumulator and high and low pressure alarms.

* * *

The Steel Pipe Line

THE pipe used is API line pipe, either seamless or electric welded, and conforms to API Spec. 5L (11th edition) or ASTM A-53. Since the war only 3 sizes of steel pipe have been available, 5, 6 and 8 inch I.D. A wall thickness of ¼ inch has been universally used with the exception of the Big Thompson Tunnel installation at Denver, which employed a 155-mil wall. A 188-mil wall will be used at Columbus on part of one line. The pipe comes in double random lengths of about 40 feet.

* * *

ENDS are of the bell and spigot type or flared for chill rings. The bell and spigot type permits the cable to be pulled in one direction only, but if the inside edge of the male end is rounded off, this is no longer true. If chill rings are used, the clearance between them and the fairway must be generous, otherwise the edge of the chill ring could project into the fairway at bends in the line and tear the cable as it is pulled in. Test pigs pulled through the pipe on several installations have jammed against projecting chill rings. Properly

done and inspected either method is satisfactory. The writer prefers the bell and spigot.

* * *

TESTING of the welds is done with a pig, Fig. 16, on the inside with a pressure of 500 psi and a water trough outside. After the entire line is welded, a pressure test section by section is sometimes made at 400 or 500 psi, and any drop in 72 hours noted. This test seems unnecessary, however.

* * *

THE protective coating almost universally used for pipe cable is ½″ thick and is 50 per cent more expensive than the coating used on illuminating gas lines. After the pipe is cleaned and a primer coat of asphalt applied, a hot mixture consisting of 85% balanced aggregate (max. grain size ⅛″) 1% asbestos fiber, and 14% by weight of asphalt is extruded over it. The rock aggregate carries the weight of the pipe, the asbestos gives tear strength, and the asphalt coats the grains a few mils thick and acts as a moisture seal. The coating is so strong and flexible that the coated pipe can be bent in the field applying the bending force through the coating. Below 40° F. the coating becomes brittle. After the application of the coating, it is tested for pinholes with a spark tester device, giving a peak of 20 to 30 kv. (Fig. 17). When a hole is located a bell rings. The hole may be readily patched with a blow torch and putty knife. The testing is repeated when the pipe is received at the storage yard near the pipeline site, it is tested again after delivery to site. Such testing can hardly be overdone. The coating is applied over welds in the pipe with molds, the thickness here being 1 inch, and these likewise are spark tested. This coating, when new, should have a resistivity of at least 3 megohms per sq. foot, but this value often runs as high as 100 or 200 megohms per sq. ft. After the passage of years the resistivity drops to a steady value of the order of 100,000 ohms per square foot.

* * *

THE pipe is not coated inside. Of course, if a cable without continous sheath is used and the pressure medium is oil, internal coating may be desirable. It seems wiser, however, to put the extra 25 cents a foot on the cable sheath.

* * *

THE coated pipe is buried with at least 40 inches cover in a trench minimum 24″ width. The bottom of the trench is made free from stones and sometimes a bed of screened earth is first put in as a bedding. The pipe is covered with screened backfill, using a 1 inch blocked screen, to a depth of 12 inches, and then this fill is well tamped.

* * *

IF two pipes are laid in the same trench, it is usual to separate them 18″ centers, although mutual heating will reduce the current carrying capacity of each line by over 10 per cent. If a spacing of 36″ centers were used, no mutual heating would take place under normal conditions. For two pipes spaced 18″ centers it is usual to cut a trench 32″ wide.

* * *

THE pipe coating sooner or later will develop pinholes or cracks. These must be located by annual inspection and repaired. It is desirable that the pipe be cathodically protected. Kidder has shown that usually by judicious bonding the pipe can be made ½ volt negative. The usual practice is to use a 2 volt station battery capable of carrying the entire short-circuit current of the cable to ground. A rectifier keeps the battery charged. The latter is by-passed with a gap with a paper spacer to take care of transients.

* * *

Manholes

THE simplest type of manhole is shown in Fig. 6 with dimensions. Two openings are required to permit pulling the cable into the

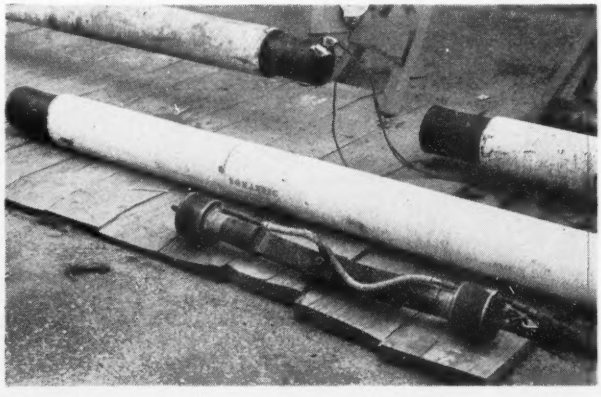

Fig. 16—Test Pig. Tire on each side of weld is inflated at 600 psi, then space between is filled with nitrogen at 500 psi. * * * * *

Fig. 17—High voltage spark tester. * * *

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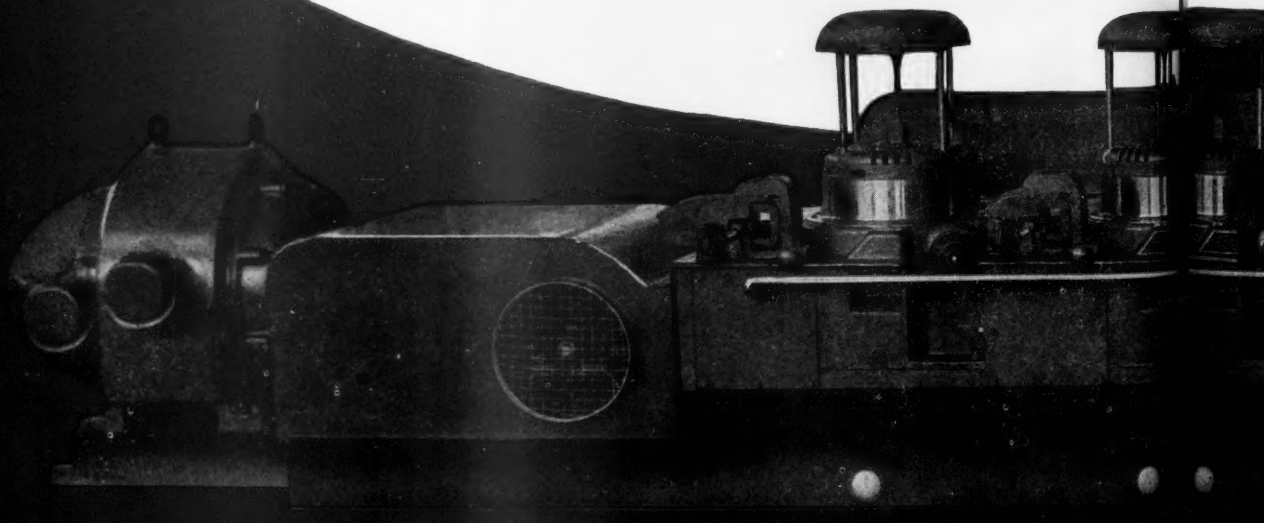

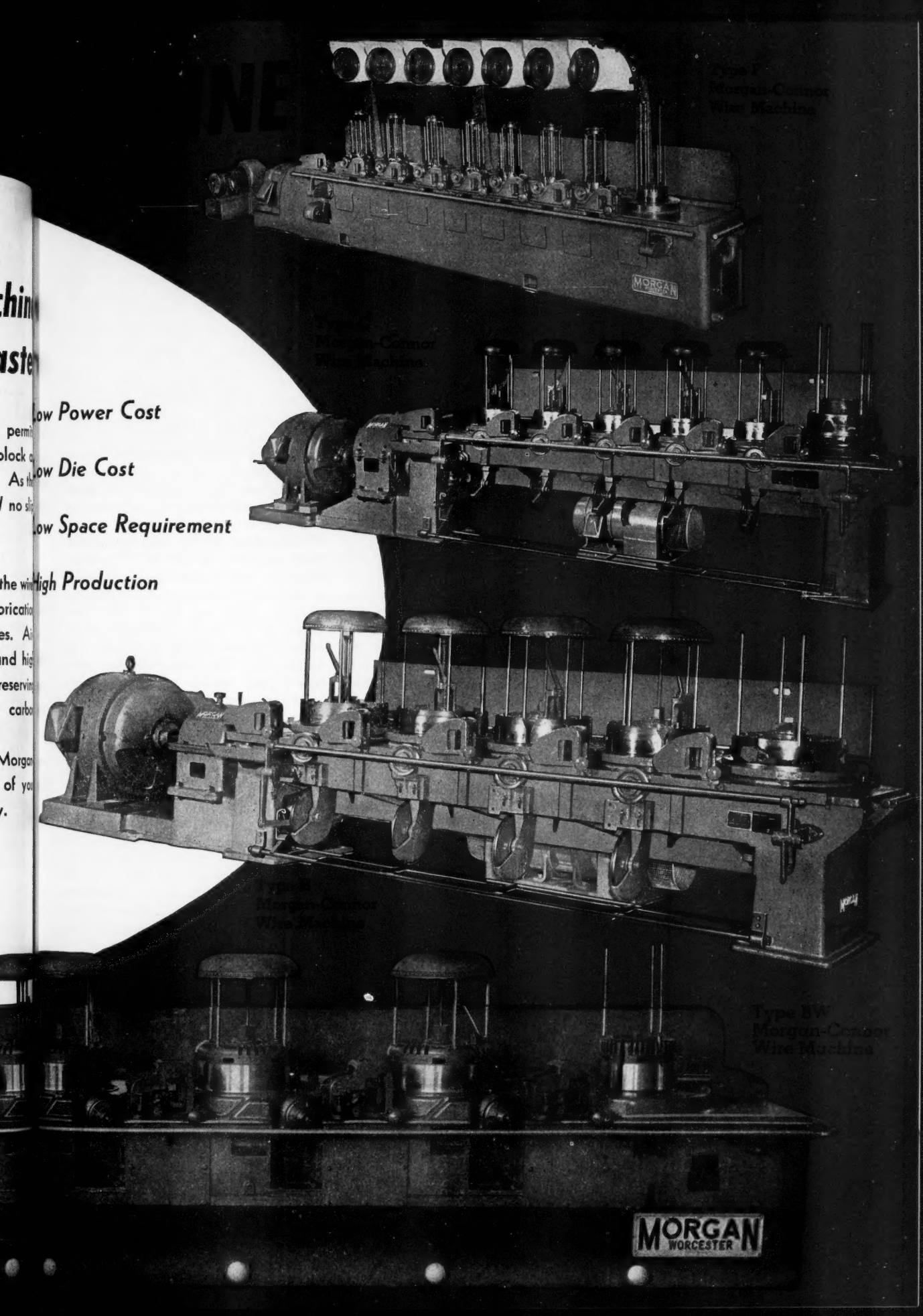
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pipe from either direction. One opening is made permanent, the other is filled with a concrete cover.

* * *

Cable and Pipe Joints

THE cable joint is similar to a solid cable joint, Fig. 7. Compression connectors are used up to 1,000,000 CM and above that pin-type connectors. The hand-applied insulation is oil impregnated paper and an effort is made to get this as tight as possible so as to obtain a hard core. The polyethylene sheath of the cable is carried across the joint with self-adhesive polyethylene tapes reinforced by varnished cambric and bronze tapes. The shielding tape is grounded by bringing out a flat copper tape zig-zag fashion through the taped polyethylene sheath. The joint is sufficiently strong that in the laboratory it passes a 48 hour test at 200 psi internal gas pressure without difficulty.

* * *

THE steel pipe sleeve at the cable joint is arranged in two parts so as to slide back and allow the cable joint to be worked on without requiring a large manhole. The two end welds are provided with a long heat path so that the cable within is not injured.

* * *

Stop Joints

A JOINT that sectionalizes the gas or oil pressure medium but not the oil in the insulation is called a stop-joint. In other systems where the cable is not provided with a continuous sheath, the pressure medium can seep through the insulation at the stop-gland and such a sectionalizing joint is then called a semi-stop joint. The stop (Fig. 8) usually consists of a barrier plate at either end of the steel pipe fitted with three stuffing boxes through each of which a cable core is threaded. The packing is tightened up by a screw device and the stuffing squeezes the insulation. By-pass piping around the stuffing glands is provided and contains valves for sectionalizing the line if necessary.

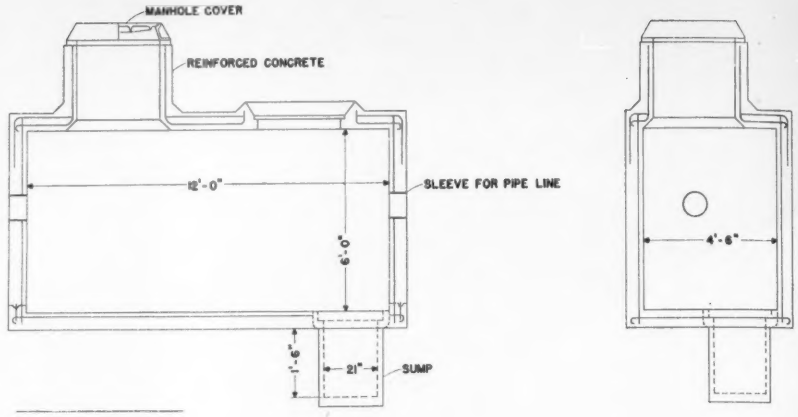

Fig. 6—Manhole for 120 Kv. Pipe Cable.

* * *

STOP-JOINTS are at best a necessary evil. In most cases where they have been used they are an unnecessary evil. The cable is restrained and squeezed by the stuffing box just after it has bowed out from the smaller cable pipe into the larger diameter pipe sleeve. Conductor expansion forces may cause very considerable thrusts on the joints which may bend the cable sharply, damaging the insulation; or the outer layers of insulation at the squeeze gland may slide out of place. This danger does not appear so great with a metal-reinforced continuous sheath cable as with the unsheathed cable. Certainly the squeezing out of oil from the insulation at the stop into the gas-filled pipe applies only to cables with a taped sheath or no sheath at all. With the latter types of cables two stop-joints recently failed and the writer believes these would never have occurred had they been normal.

* * *

THE stop-joint is a departure from the cardinal virtue of simplicity so essential to trouble-free

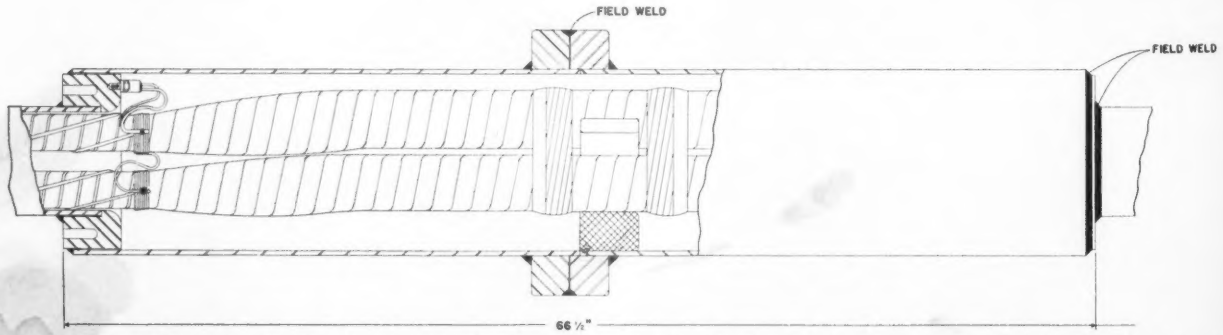

Fig. 7—Normal Joint.

operation of high pressure pipe systems. At least 4 valves are attached to the by-pass piping in most stop-joints, any one of which may leak or which may accidentally be left turned off when it should be on, so that pressure is not communicated to the remainder of the line. Experience has shown these safeguards are always complicated and are usually the sole source of trouble. The semi-stop joint seems to have been introduced originally for installation purposes of cable whose sheath had to be stripped off as it was pulled into the pipe. That was in the days when every joint (or sometimes every alternate joint) was a stop joint and a separate degassing and oil-filling treatment had to be carried out for each length of cable. Even today some engineers advocate "every joint a stop-joint." The extra material and labor expense over a normal joint is a serious consideration, especially when the system is electrically and mechanically weakened.

★ ★ ★

A PIPE system should be first laid out without any stop-joints whatever. Later, upon going over the route and examining the profile, some good reason may be found that justifies a stop-joint. With the gas medium there is no reason for a stop other than the cost of replacing the gas should excavators accidentally make a hole in the pipe, because the Oil-Filled Gas-Compression Cable can be operated safely for 24 hours without pressure in any case. Another reason for no stops with this type of cable is that if a break did occur in the pipe and ground water got in, it would not in any way hurt the cable because of its continuous sheath. Utility engineers have expressed the view that the cost of replacing the nitrogen in 2 or 2½ miles of pipe for the number of times it is likely to happen in a 40-year statutory life is not of importance and so have requested stop-joints only at these intervals. With the ease of obtaining bulk nitrogen today and its low cost, the writer sees no need for any stop joint whatever in the average line, which is about 5 miles in length, with the understanding this statement is limited to the Oil-Filled Compression Cable System for the reasons given above. The cost of replacing the gas is small compared with that of excavating two holes in the streets and freezing an oil-filled pipe solid with carbon dioxide snow, an operation, incidentally, which is not done in a day. With other cable systems the fire hazard, danger of water entry and consequent damage to the unsheathed cable, inability to operate 24 hours without pressure, and other considerations, may make more frequent use of stop joints desirable.

★ ★ ★

A NON-SQUEEZE type stop-joint has been designed for the Compression Cables. This is possible because of the continuous sheath.

★ ★ ★

Terminal Arrangement

AT the ends of the pipe line the three cables are brought out through a spreaderhead into individual non-magnetic tubes which bend upward to the base of the three terminals mounted in line on a galvanized iron structure about 15 feet above the ground. It is best to bring the steel pipe vertically out of the ground by a 6-foot radius bend, and then to mount the spreaderhead on it about 6 inches above the ground level. The vertical bend serves to anchor the pipe against any serious movement. It also provides room for the cable to move and helps absorb thrust or contraction of the cable due to changes in loading. The cable passes through a non-squeeze stop-gland as it enters the base of the pothead to stop the oil from running out of the latter in case of damage to the copper tube, and sometimes to serve as a separator between the gas in the pipe line and oil in the pothead.

★ ★ ★

MECHANICALLY, the terminal ends, including the 3 copper riser tubes, 105 mils in wall thickness, and the porcelain terminals are the most exposed and fragile parts of the system, whereas the ¼ inch steel pipe line is an exceedingly strong container which is usually worked for oil transmission lines at 900 psi and which has a bursting strength for the 6 inch

(*Please turn to page* 914)

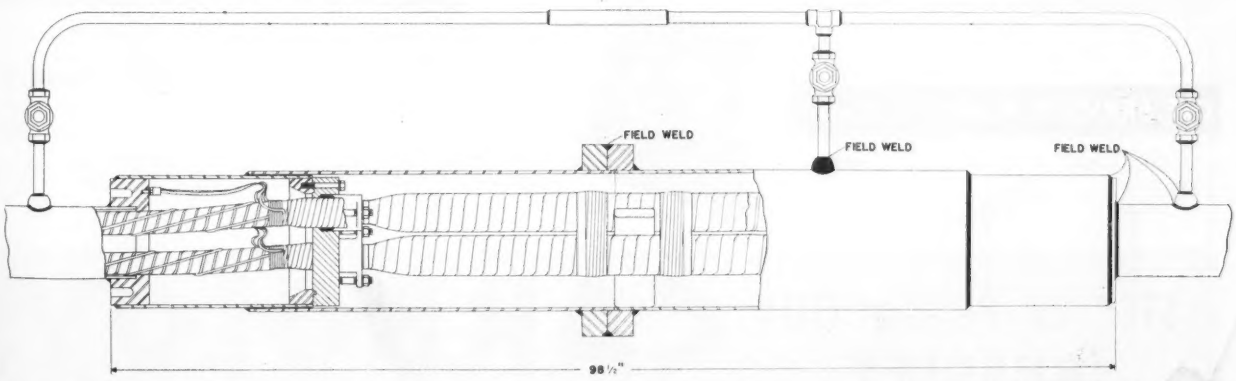

Fig. 8—Stop Joint.

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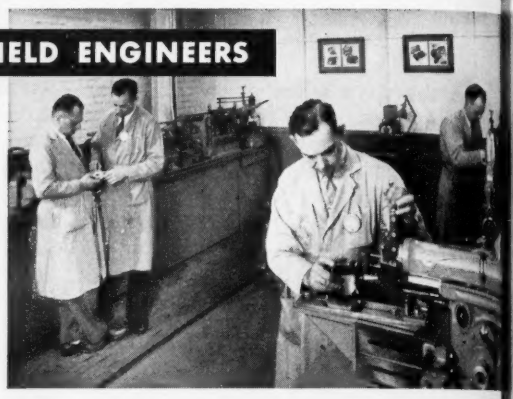

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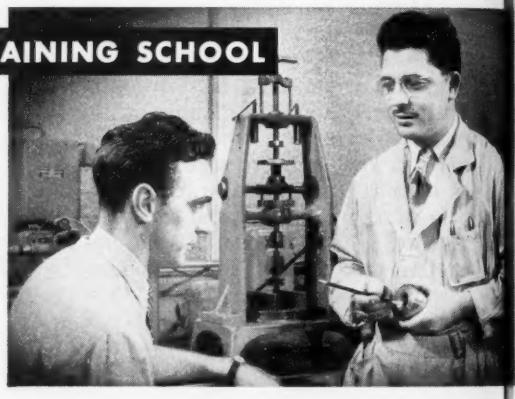

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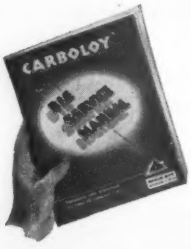

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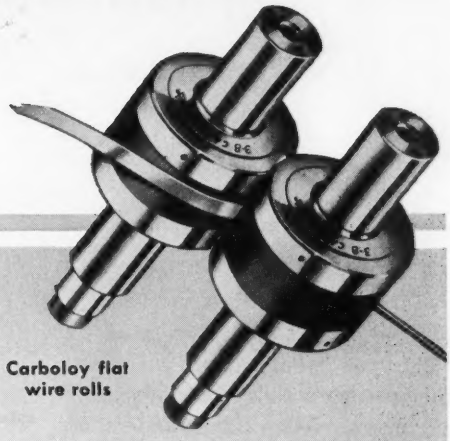

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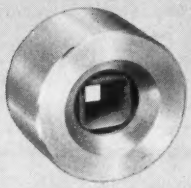

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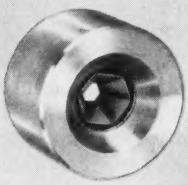

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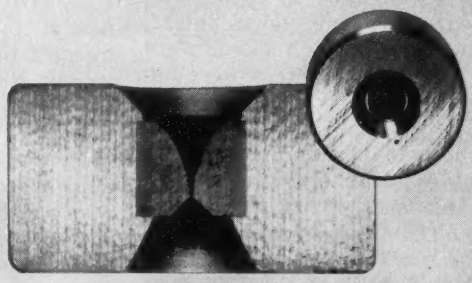

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Material Handling at the Rod and Wire Mills of the Western Electric Company

J. E. Wiltrakis
Assistant Superintendent
Factory Planning
Kearny, N. J.

and

By A. A. Bureau
Department Chief Material Handling
Hawthorne Works
Chicago, Illinois

A description of the material handling methods of the Western Electric Company at their various wire plants. A paper presented at the Wire Association Convention held in Baltimore, Maryland, October 23-26, 1950.

IF you had visited the Hawthorne Plant of the Western Electric Company at Chicago, Illinois, in 1920, you would have witnessed the intense activity of a group of engineers, technicians and shop employees engaged in copper rod and wire drawing development. Machines of very high speeds were being designed and steps were being taken to provide adequate facilities to supply large quantities of copper wire of suitable sizes and quality required for the various needs of the communication industry. This was a part of Western Electric's contribution to the continuous effort of the Bell System to provide better and lower cost communication service to its customers.

★ ☆ ☆

THE results of these activities materialized several years later in the completion of the Hawthorne Rod and Wire Mill which met the original objectives. Since that time, the needs of the Western Electric Company have expanded materially and they have been met by improvements in machinery and methods at Hawthorne and the provision of additional capacity in new installations.

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THREE additional mills have since been completed. The wire mill located within the Cable Plant of the Pt. Breeze Works at Baltimore, Maryland, started operations in 1931. At the Kearny Works in Kearny, New Jersey, one of the Western Electric Company buildings was equipped for wire drawing in 1939. The fourth was completed in 1946 as a part of a newly formed wire and cable manufacturing plant at Tonawanda, New York.

★ ★ ★

THESE four plants have recently consumed annually approximately 200,000,000 lbs. of non-ferrous rod for the various communication products such as underground cables for connecting telephone exchanges and toll equipment, aerial wire and cables used for open line circuits and wires such as drops for connecting subscribers' phones. Some of it is used for connecting the various apparatus and equipment, some of the bronze wire is made into tinsel for telephone cords, and many thousands of miles annually become part of the numerous relays and coils. The copper wire drawn in these four mills is a significant portion of the total footage of wire drawn in all the wire mills of the United States.

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IN planning these four installations, a great deal of consideration was given to the methods and costs of transportation of copper from outside suppliers as well as the efficient handling of materials within the mills. In addition, material handling studies resulted in novel applications in the mills and were coordinated with the design of wire drawing, annealing and subsequent insulating equipment.

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THIS paper will provide an outline of the part material handling equipment and methods played in the production of low cost non-ferrous wire of the high quality required for communication products. The first part of the paper will describe the handling of bars and rod in the Hawthorne Rod Mill. The second part will describe various material handling equipment and methods used in each step of the manufacturing process at the four wire mills.

★ ★ ★

Copper Rod Mill

Fig. 1: Interior view of Hawthorne Rod storage area showing rod coilers and conveyor in foreground

PRODUCTION methods for rolling rod in the Hawthorne Plant follow the usual operations of heating the wire bars, rolling into ¼" section and coiling for drawing into wire. Utmost economy of movement and maximum utilization of floor space were among the prime considerations in keeping operational costs low. At the Hawthorne Plant, rod rolling operations start with the receival of copper wire bars from outside suppliers. This Plant is so situated that wire bars must be delivered by rail in box cars under seal. In order to comply with the Interstate Commerce Commission regulations, the load must be uniformly distributed over the entire car floor and this is accomplished by placing the bars across the width of the car down the center and loading additional bars longitudinally along both sides of this center load.

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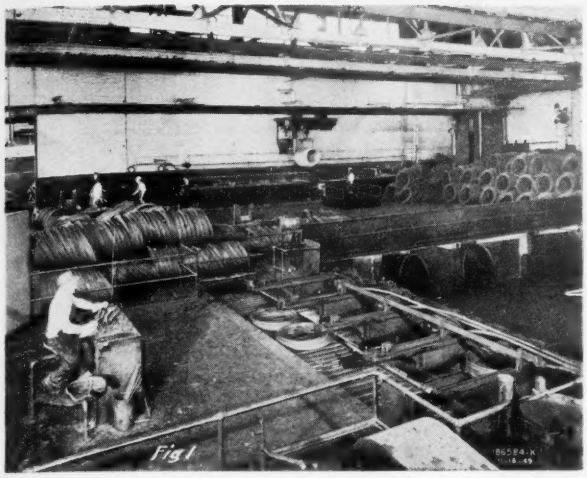

Fig. 2: Bars handled with air hoist grapple on portable bridge in freight car

A SAFE and economical method has been devised to remove these bars which are 60″ long and 4″ square and weigh 230 lbs. each. Six light weight alloy rails are placed at intervals under the roof across the freight car. These rails are spaced to accommodate a portable light alloy monorail bridge on which is mounted an air hoist equipped with a grapple. The I beam rail used for the bridge has a shoe on one end with four hardened steel spikes and on the other end a square thread jack screw which has another shoe mounted on a ball joint. When the rail is in proper position, the screw is turned wedging the shoes into the car walls, thus securing the rail. A cradle consisting of two "L" shaped angles for holding the bars while making up the load is set on the car floor and the wire bars are loaded into the cradle in units of 24 which weigh 5,500 lbs. and tied with one 10 gauge steel wire in the center of the load.

★ ★ ★

Fig. 3: Industrial fork truck transporting bundles of wire bars

THESE bundles are removed from the car by an electric fork truck and stored, tiered three high, in the rod mill. High utilization of floor space is obtained by this tiering method. Average loading in the bar storage area is 1,500 lbs. per sq. ft.

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Fig. 4: Grapple on monorail hoist places bars on furnace conveyor

THE fork truck later transfers the bundles to a cradle at the charging end of the furnace. A monorail hoist with grapple lifts one layer of six bars, 1,400 lbs., from the unit load and places the bars on the charging table of the furnace.

★ ★ ★

Fig. 5: Heated copper bar mechanically placed on conveyor to breakdown rolls

AT the end of the furnace the heated bars are mechanically placed on a conveyor and their rate of feed into the rolling mill is manually controlled. The mill is of commercial design with mechanical handling through the breakdown rolls and with both mechanical and manual handling through the intermediate and finishing rolls.

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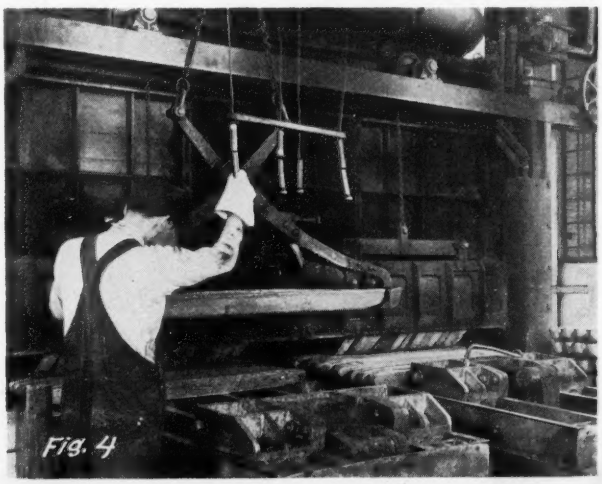
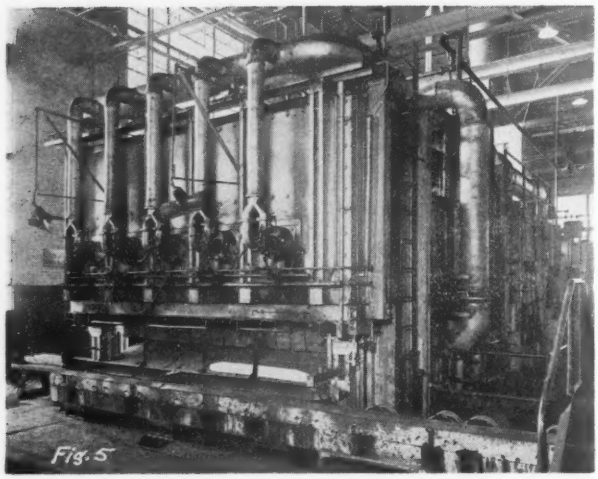
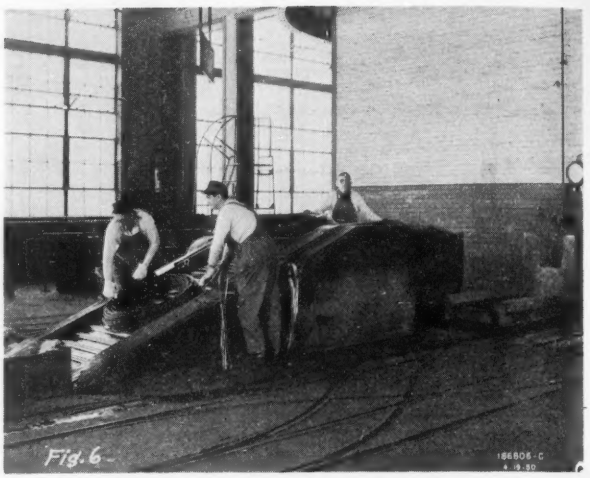
AFTER the bars are rolled into ¼″ rod they are coiled by an automatic take-up as shown in the

Fig. 3 below







first picture and placed on a platen conveyor where they are cooled by water.

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Fig. 6: Coils tied at end of conveyor where ten coils of rod are loaded into each transfer car on movable floor platform

THIS conveyor transports the rod up an incline to facilitate the manual tieing of coiled rod with copper wire. This is done to keep the coils intact for subsequent handling. An operator controls the loading of one of the three transfer cars at the end of the conveyor. When the car is filled with ten coils, the floor level platform, on which three similar cars are located, moves the coils of rod at right angles to their original direction of flow, bringing them to either side of the conveyor. The car containing rod is then either unloaded with the rod being transferred to the pickling tanks or it is moved over narrow gauge tracks from the platform to the floor for subsequent unloading to storage. In the meantime, another car is being filled.

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Fig. 7: A hair pin hook on a floor operated bridge crane used to transfer rod to and from storage

THREE methods have been used to deliver rod to storage. With an industrial truck, it is possible to stack bundles containing ten coils of rod, two layers high. This method is not being used because sufficient space is not available for two level storage or for maneuvering of trucks. Three coils high could be stored with an overhead cab type crane, but this requires the use of two operators—one in the cab and one on the floor. A floor operated crane with a hair pin hook is now being used to store rod, three coils high, controlled by one operator.

Fig. 8: Electric tram rail hoist on monorail removing rod from cleaning tank

THE coiled rod which is picked up direct from the transfer car at the rod cooling conveyor or taken from the storage area is handled over a monorail system which moves the rod through the pickling and washing tanks for transfer direct to the wire drawing machines. Two two-ton electric tramway hoists are operated over this monorail system. They consist of a rigid framework suspended on two trolleys which are powered for horizontal speeds up to 400 ft. per minute.

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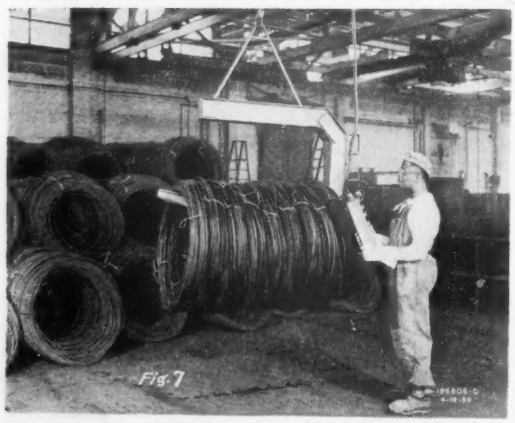
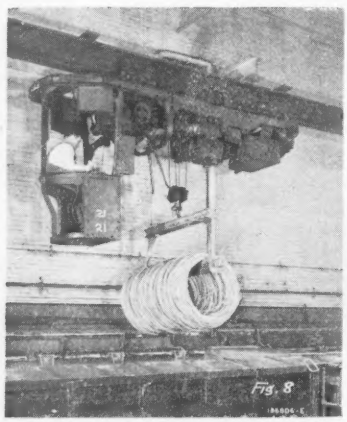
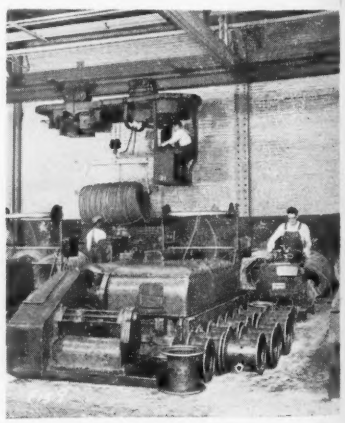
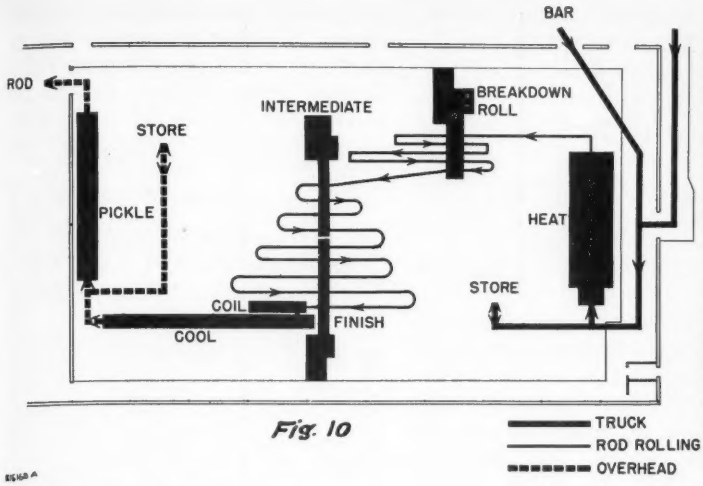
Fig. 9: Rod delivered to wire mill by tram rail

THE operator's cab is suspended at one end of the carriage giving the operator unobstructed view of the hoisting operations









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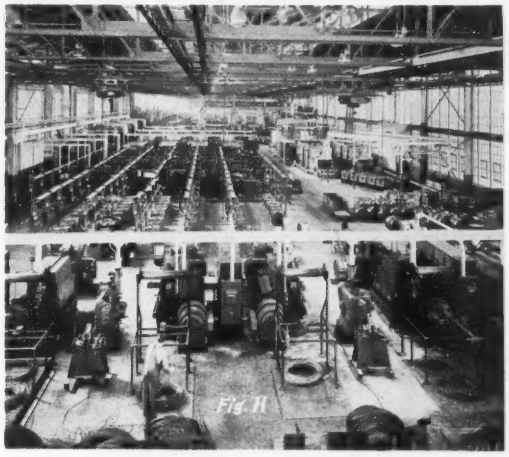

Fig. 11

which can be done at a maximum speed of 65 ft. per minute. A yoke type carrier with a removable load bar is used for placing material to be processed in a department in orderly fashion and a minimum of space is required in these locations for operation of this type carrier.

★ ★ ★

Fig. 10: Flow chart of Hawthorne Rod Mill

THE movement of the material from the point of receival of copper bars in freight cars to storage and through the heating, rolling, coiling, rod storage and cleaning prior to delivery to the wire mill is shown in the flow chart layout.

★ ★ ★

Material Handling in the Western Electric Wire Mills

Fig. 11: General view of Tonawanda Wire Mill

THE floor space occupied by all the Western Electric Company manufacturing plants totals 17,000,000 sq. ft. This is equivalent to the floor space in eight buildings of the size of the Empire State Building in New York City. The four wire mills take less than 1% of the total manufacturing area. Of this, only a small part is used for the storage and wire handling in the wire mills. Several factors account for the small proportion of floor space being used to manufacture the large quantities of non-ferrous wire required by the Bell System. Large quantity production of relatively few sizes of wire, the use of high speed machines, the use of large spools of wire and the introduction of improved handling methods and equipment were the principal factors which reduced time cycles between operations and resulted in improved space utilization.

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IN view of the fact that the Western Electric Company has four mills, designed and provided at different periods under different local conditions and with specific objectives, an interesting comparison and analysis of material handling equipment and methods can be made. This will be covered by the presentation of a composite picture of the devices and methods used in the handling of material through the principal steps common to the four wire drawing installations. Operations not common to all of the four mills have been omitted, such as the manu-

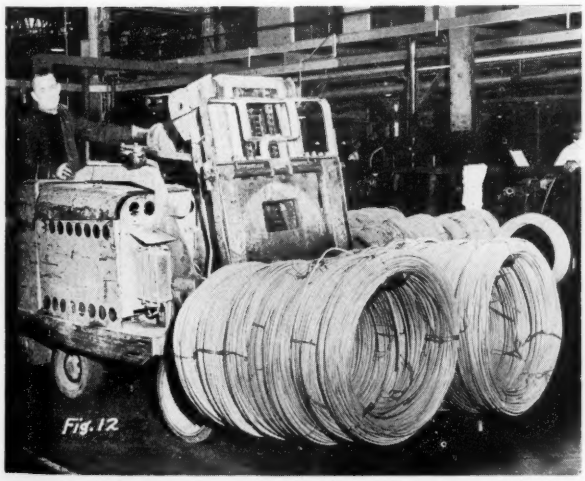

Fig. 12

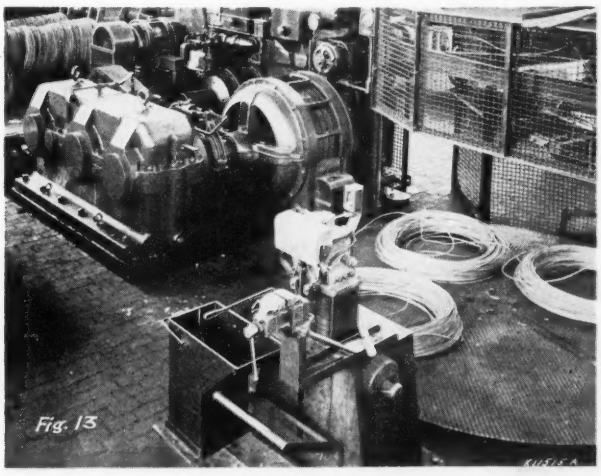

Fig. 13

facture of tinsel or aerial, bronze, tinned, enameled and magnet wire. The objective is not to describe each wire mill, but to record various solutions reached to similar material handling problems.

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AS all or most of you know, the principal operations in a copper wire mill making 19 to 26 AWG wire consist of the following: rod receival, #1 drawing, #2 drawing, annealing, final inspection and shipping of wire.

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Delivery of Rod to No. 1 Drawing Machines

Fig. 12: Electric truck delivering 3,600 lbs. of rod

TRUCK or rail deliveries of copper rod in 225 lb. coils are made from Hawthorne or outside suppliers to the local receiving platforms at Pt. Breeze, Kearny or Tonawanda. Here 2,250 to 3,600 lbs. of rod are unloaded at a time with either a single boom truck or with a fork truck and placed at the supply stands of the No. 1 machines or in storage. Industrial trucks store rod two coils high, being supplemented by a floor operated crane with a hair pin hook where rod is stored three high.

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AT the drawing machines the coils are placed at the supply

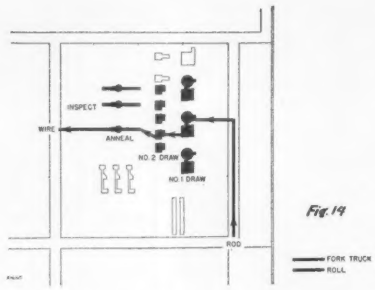

Fig. 14

end of the machines and welded to preceding coils to form continuous lengths. In the case of the higher speed, 5,000 f.p.m. machines, each coil of rod is consumed during operations every 2¼ minutes when making 12 AWG supply wire. It is evident that at these higher speeds the rod would snarl and knot unless properly located and, in addition, the whip of the rod would be hazardous to the operator even though a push bar were used to position the rod.

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Fig. 13: Supply table for four coils of rod at high speed #1 machines

TO provide safety and correct positioning at the higher speed machines, a heavy wire mesh guard encloses an 8′ diameter turntable at each drawing machine with positions for four coils. As the rod from one coil is consumed, the operator pushes a button and the table is mechanically rotated through 90 degrees, placing the next coil in position. This provides space adjacent to the welder for the next coil and insures a dependable supply with safety to the operator. The following chart shows the flow of copper rod to the high speed machines at Point Breeze. Here, copper rod is received and converted into wire. Copperweld and bronze is also drawn.

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Fig. 14: Flow chart of copper rod processed into wire in Pt. Breeze mill where copperweld and bronze wire is also processed

THE design of the wire take-up reels used on the No. 1 machines was determined principally by the type and speeds of the machines, the weight of the wire on the reel and the objectives of low maintenance costs and safety. The three principal types of reels used are:

a. 300#
b. 1000# for 3500 f.p.m. machines
c. 1000# for higher speed machines operating at 5000 f.p.m. and 6300 f.p.m.

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FOR instance, the 1000# reel used in the higher speed machines consists of high tensile cast steel flanges welded to a steel drum. These reels weigh 150# each and, when filled, have a gross weight of 1150#. The physical dimensions are 24″ dia., 20″ traverse, 22-½″ length and the rim is 1-¼″. These reels when used to draw 12 or 14 GA supply wire at 5000 f.p.m. have a maximum peripheral speed of 7700 f.p.m. The maximum peripheral speed is 9700 f.p.m. for the 1000# reels when used on the No. 1 Machine of re-

Fig. 15

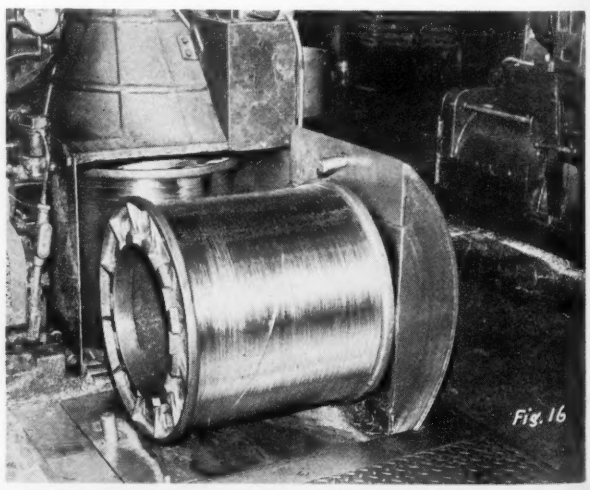
Fig. 16

cent design which converts 5/16" copper rod into 14 and 16 gauge wire at 6300 f.p.m.

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Supply Wire to No. 2 Machines

VARIOUS means are used for handling the reels from the No. 1 to the No. 2 machines where they must be up-ended and the wire is welded to form continuous lengths of supply wire. The following comparison and analysis shows that the facilities used were determined by the floor layout, the weight of spools handled and the availability of facilities such as cranes.

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Fig. 15: Industrial truck equipped with ram for transporting four reels of wire

WHERE the distance between machines exceeds 60 ft. and 300# reels are used, an industrial truck equipped with a ram is used to transport four reels weighing 1200 lbs. At the No. 2 machines, the 300# reel is up-ended by hand at the supply end of the drawing machine.

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WHERE the distance between machines is 30 to 60 ft., an overhead crane is available and 1000# reels are used; the reels are mechanically up-ended and transported. A device has been designed to grip the 1000# reel so that it can be lifted by the aid of a floor operated crane.

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THE 1000# reel is delivered to one of the 30 supply stands of the No. 2 machines. Two stands, about 6" above the floor, are available for each machine. The reel is lowered into the emptied stand. Here the wire is welded to the end of the wire on the adjacent reel. Continuous supplies of wire are pulled through guides in overhead channels to the entrance of the No. 2 machines.

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Fig. 16: Up-ending device for rotating 1000# reel from horizontal to vertical position at floor level

IN the installations where the distance between machines is 20 to 40 feet, the reels are rolled to interim storage and when required they are up-ended with a mechanical device located on the floor at the supply stand. Up-ending must then be performed without excessive jarring of the reel to prevent snarling of wire and with safety to employee.

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ONE device used where cutting through the floor was not objectionable, consisted of an "L" shaped cradle into which the reel is rolled. The reel and cradle are rotated 90 degrees by an electric motor drive in the floor. Rollers below the reel facilitate the pushing of the reel into position on the supply stand at the No. 2 high speed drawing machines.

★ ★ ★

Fig. 17: 1000# reel up-ended by motor operated cradle in floor at supply end of No. 2 Machine

THIS up-ending device could not be used at one of the mills because the floor could not be cut to provide the space. An up-ending device was required which would not occupy more than 3", approximately the thickness of the wood block floor.

★ ★ ★

Fig. 18: Sketch of up-ending device consisting of two 3" castings

THE value of the up-ending device pictured is apparent to anyone who has tried to up-end a heavy object without jarring. The device pictured consists of two flat castings identical in shape that dovetail together to form a large hinge within a base member. The reel is rolled on to one casting, a pneumatic hoist lifts the castings and the reel to approximately a 45 degree angle, slightly past center of gravity, and as the air is exhausted the reel is gently lowered to conveyor rollers.

★ ★ ★

Fig. 19: Reel being up-ended by pneumatic hoist at No. 2 Machines

CONTROLS are adjacent to the welding machine where the operator can safely control the up-ending of the heavy reel. Construction and maintenance costs have been extremely low and it was unnecessary to cut through the concrete reinforcing rods in the floor.

★ ★ ★

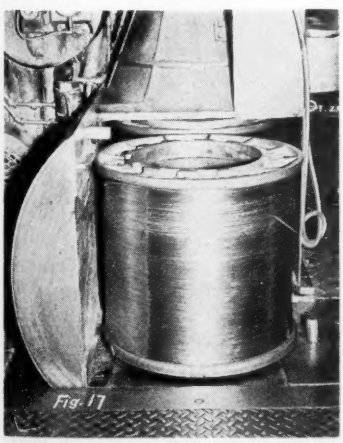
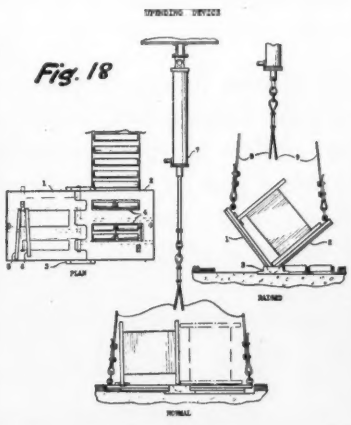


Fig. 17



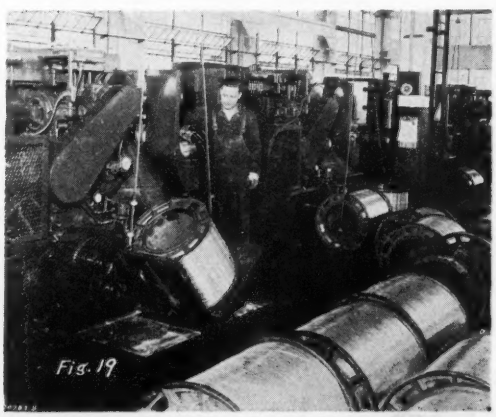


Fig. 19

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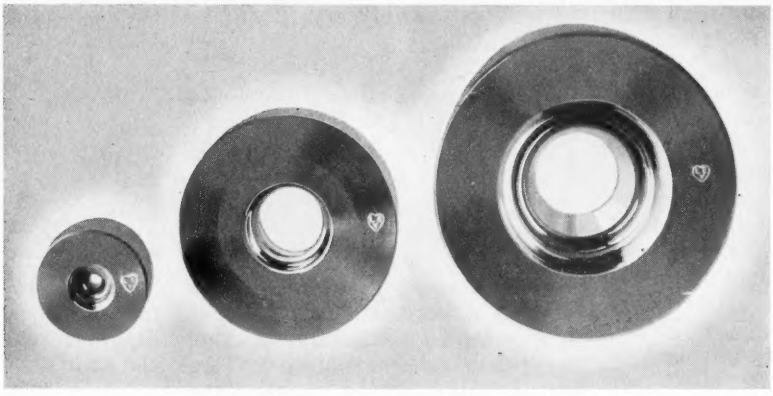

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YOU will note that in the four mills there are four different methods for up-ending reels, the manual method being used only with the 300# reels and three mechanical methods for the 1000# reels.

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TWO spools are used at the various types of No. 2 machines and the annealing furnaces. For lower speeds the 60# spool is used and for higher speeds the 400# spool is used. High tensile steel castings are used for the 400# spool which weighs 50# when empty. The maximum peripheral speed of this spool, 17-5/8" in diameter, when drawing Nos. 19 to 26 AWG wire at 10,000 feet per minute, is 16,000 f.p.m.

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IN 1937, when the present high speed machines were installed, they were and to the best of our knowledge still are the fastest drawing machines used for copper drawing. The maximum speed at which wire can be drawn and at the same time provide an adequate factor of safety is that speed where the stress in the wire set up by the centrifugal force is equal to the safe stress for copper; namely, approximately 25,000 lbs. per sq. inch. This is equivalent to a drawing speed of 27,000 ft. per minute. The inevitable question automatically follows: Why not draw that fast? The only answer to that is that the materials used in the take-up spools would not safely take the stresses. At 27,000 ft. per minute the stress in the take-up spool would equal 62,000 lbs. per sq. inch. In order to maintain a factor of safety of approximately 5 to 1, the maximum speed of 12,000 ft. per minute was used. Each one of the spools used in various machines have been designed to rigid Western Electric Company specifications for the particular usage in the machines in which they are run and the handling, storage and subsequent processing operations.

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Wire Delivered to Annealing Furnace

FROM the No. 2 Machines, the bulk of the tonnage of the Western Electric copper wire must be delivered to annealing furnaces. After annealing, the wire is inspected before transfer to subsequent processing operations.

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Fig. 20: Expansion arbor lifting device for four 60# spools

IN one mill where 60# spools are used, they are loaded by hand into a metal bin which is transported by an electric truck to the table of an annealing furnace. The 60# spools are lifted four at a time in a horizontal row with a lifting device consisting of four expansion arbors placed in the center holes of the spools. The spools are placed on the conveyor of the pusher type continuous annealing furnace. They are unloaded in a similar manner four at a time after annealing.

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Fig. 21: Gravity conveyor at No. 2 machines for 60# spools

IN a second installation, the 60# spools are removed from the take-up arbor of the No. 2 machines and placed on a gravity conveyor located between rows of machines. At the end of the gravity conveyor, the spools are loaded into skids with the expansion arbor lifting device mentioned previously. An electric truck then transports the skids to the annealing furnace.

★ ★ ★

Fig. 22; Fig. 23: Input and output end of continuous type annealing furnaces showing conveyors and spool lifting attachments

IN this installation the two pusher type electric furnaces are equipped with conveyors having bulk head type trays with a capacity of 30 spools each. These are loaded with 60# spools, four at a time. The single conveyor terminates at a turn-table making it possible to load either one of the two furnaces. The trays are unloaded at the discharge end of the furnace, four spools at a time, and the empty trays are rolled onto a powered conveyor and returned to the input side of the furnace. Equipment of this type is employed at two of the four mills.

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Fig. 24: Annealing furnaces of vertical conveyor type at Pt. Breeze

AT a third plant, 400# spools are rolled a short distance to an

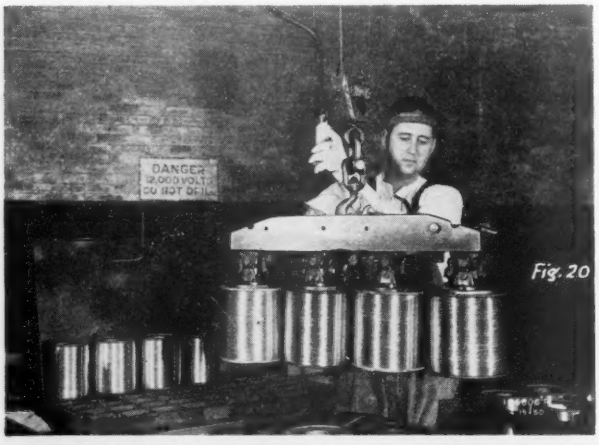


Fig. 20

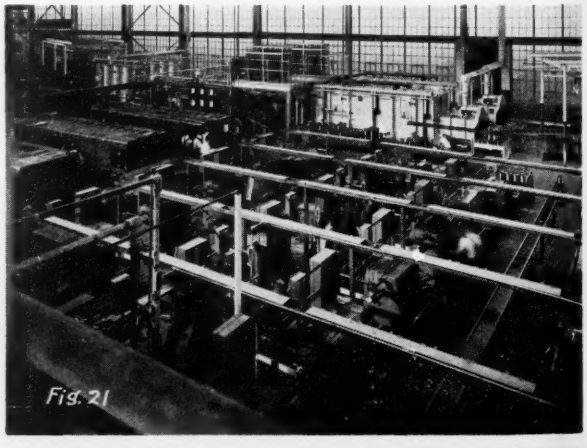
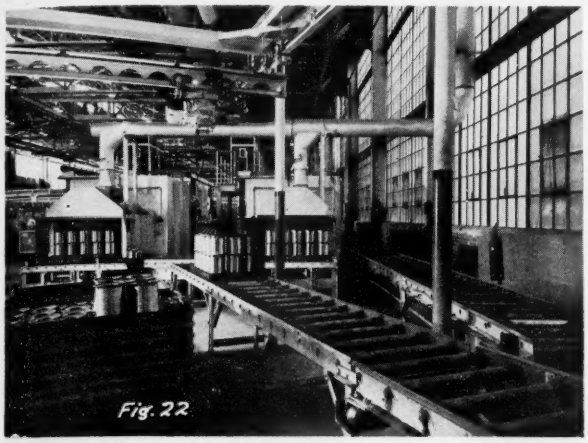


Fig. 21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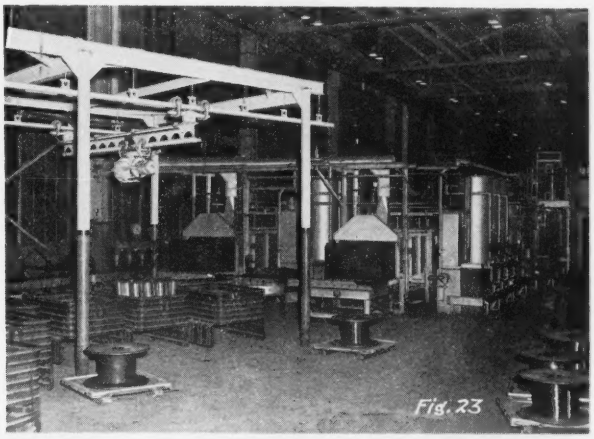
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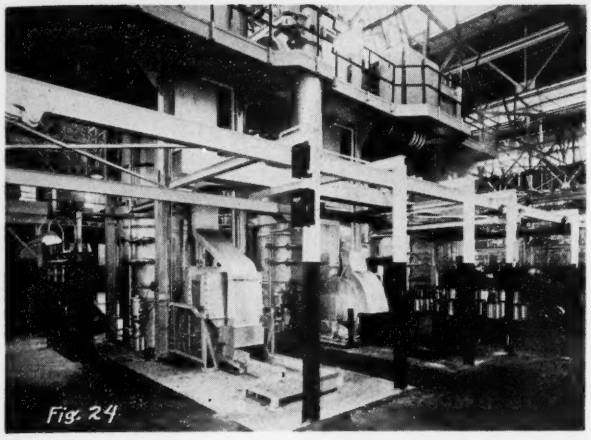
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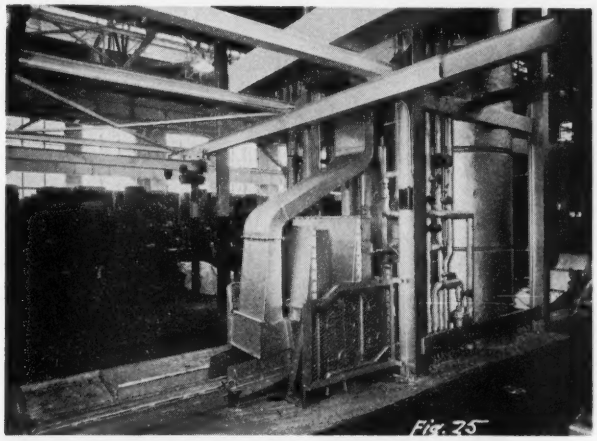
Fig. 25

inclined runway and automatically loaded into a vertical furnace.

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Fig. 25: Close-up of vertical conveyor furnace showing supply end in background and output end in foreground

IN this instance, sufficient head room was available so that the wire could be annealed and cooled while being carried by a conveyor which is an integral part of the vertical annealing furnace. After annealing, the 400# spool is manually up-ended by hand and then transferred by a hoist grapple to a storage skid. A simple flange lifting device suspended on an electric truck is used to lift the 400# spools for delivery to insulating machines.

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Fig. 26: 400# Spools being placed with boom of electric truck on skid on truck platform

THE advantage of this lifting device is its low cost and flexibility, being easily transported to location.

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Fig. 26

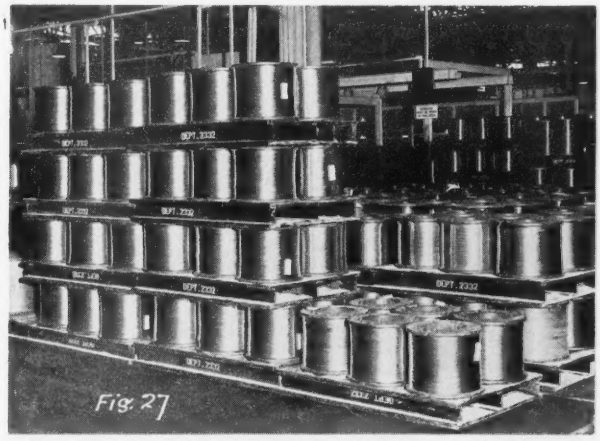
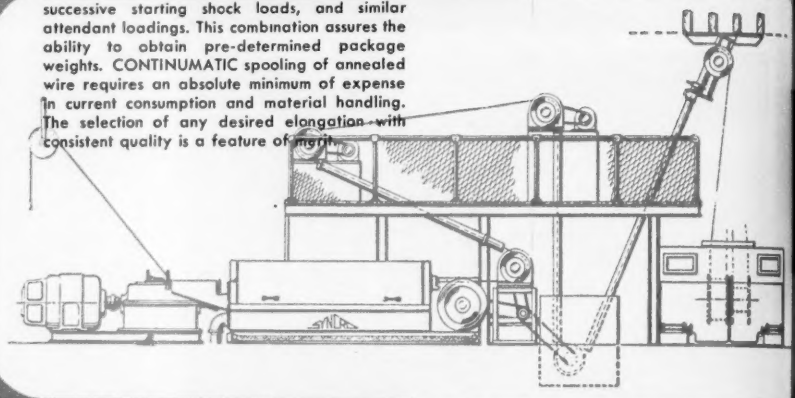


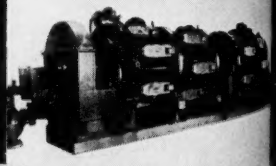
Fig. 27

One of many

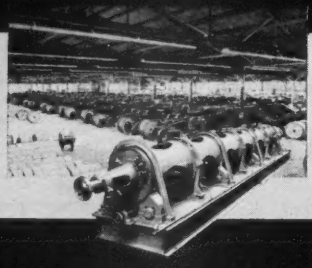
CONTINUMATIC SPOOLING

SYNCRO'S field-proven CONTINUMATIC spooling of annealed copper wire as drawn on a Rod Breakdown Drawing Machine combined with a Continuous Electric Resistance Annealer is shown in the diagram below. This combination installation produces copper wire to meet all ASTM requirements. Capacity for increased production is assured by the elimination of shut-downs due to spool change-overs. Operating and maintenance costs are reduced because of the elimination of successive starting shock loads, and similar attendant loadings. This combination assures the ability to obtain pre-determined package weights. CONTINUMATIC spooling of annealed wire requires an absolute minimum of expense in current consumption and material handling. The selection of any desired elongation with consistent quality is a feature of merit.

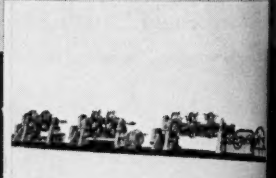




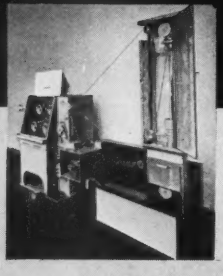
PLANETARY STRANDERS providing higher operating speeds together with SYNCRO'S side-loading cradles and safety gates.



HIGH SPEED TUBULAR STRANDERS to accommodate all standard reel sizes and any number of total wires to suit requirements of all types of wires, cables and strands. Rectangular inset shows part of large battery of machines producing ACSR strands. Outline inset shows typical view of 7-wire 22" strander for 750 RPM.



RIGID FRAME (FIXED BOBBIN) STRANDERS for multiple concentric stranding. Standard sizes from 6" to 22" reels with total number of wires to suit requirements.



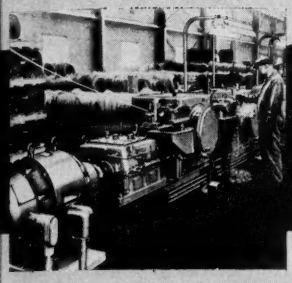
FINE AND INTERMEDIATE ELECTRIC RESISTANCE ANNEALERS for copper wire to 34 B&S guage. Field-proven with large battery installation in plants of leading wire manufacturers in this country and abroad.

SYNCRO MACHINE COMPAN

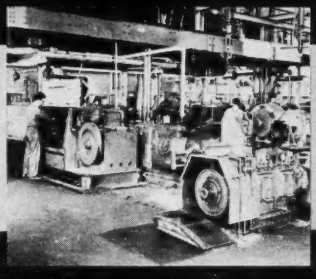
SYNCRO Advances...

in the development of Machinery for the Wire Industry

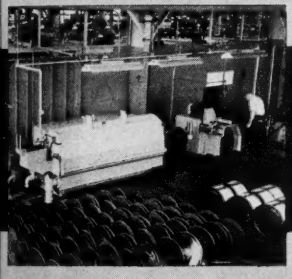
SINGLE AND DOUBLE-DECK ROD BLOCKS for rods as heavy as 1" diameter copper. Highly efficient cone-worm drives provide ample capacity. Variable speeds through AC motor drive and gear box, or, DC drive to suit requirements. Inset illustrates double-deck block incorporating shaving device for ¾" maximum entry copper rod.



MULTIPLE DIE TROLLROD MACHINES with Vertical or Horizontal Blocks arranged for wet or dry drawing of ferrous or non-ferrous materials from rods up to 1" diameter. Individual blocks are either gear or DC driven. Inset shows typical installation of an AC and gear driven machine drawing and shaving from ½" non-ferrous rod.

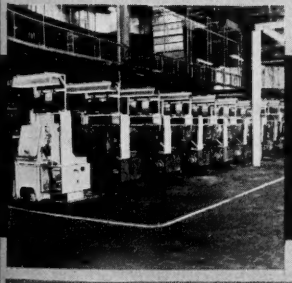


TANDEM ROD BREAKDOWN DRAWING MACHINES for production of aluminum and similar products at speeds up to 5,000 RPM. Inset shows view of 10-die machine producing aluminum wire. Can be made with any multiple die sets to suit requirements.



CONE-TYPE ROD BREAKDOWN DRAWING MACHINES for all NON-FERROUS METALS—capable of entering a maximum of ¾" diameter copper rod. Incorporating a maximum of 13 dies. These machines require a minimum of floor space and their design incorporates such SYNCRO features as individually adjustable die holders; inexpensive replaceable draw block bands; highly efficient hypoid main drive gearing. Inset shows typical view of installation with spooling attachment only. Can be furnished with coiling-type finishing block as required.

CONTINUOUS FERROUS DRAWING MACHINES - High speed continuous wet drawing machines for high and low carbon steel incorporating water cooled finishing blocks furnished with or without spooling attachments for entering a maximum wire guage of .105" and finishing as fine as .008". Inset shows typical machine.



HIGH SPEED FINE WIRE DRAWING MACHINES for all NON-FERROUS METALS incorporating SYNCRO'S well-known patented spooling device for producing clean unmarked and properly spooled wire to meet all requirements. Inset shows a typical customer repeat installation which are constantly being added for plant expansion and greater profits.

WIRE AND CABLE-COVERING MACHINES • ROD AND WIRE POINTERS • PAY-OFFS
RESPOOLERS • CONTINUOUS WIRE DRAWING MACHINES • HEAVY DUTY TAKE-UPS
CLOSERS • ELECTRIC RESISTANCE ANNEALERS • WIRE ROPE MACHINERY • CABLERS
DIE STRINGING MACHINES • STRANDERS • ROD BLOCKS • SERVING MACHINES

SYNCRO

PERTH AMBOY • NEW JERSEY • U·S·A

Affiliated Company—WINGATE-SYNCRO, • ROCHESTER • KENT • ENGLAND

Fig. 27: Pallet storage of drawn copper wire

IF the wire is to be stored, the spools are loaded upon pallets and stored as illustrated with an average loading of 600# per sq. ft.

★ ★ ★

BEFORE we review the methods being followed from the No. 2 machines through annealing, inspection to shipping at the fourth plant, the floor layout shown on Fig. 28, may be referred to:

★ ★ ★

Fig. 28: Flow Chart of copper rod processed to 19 to 26 AWG wire at the Kearny Plant

AT all plants the floor layout has an important bearing on the facilities used for the handling of materials. Twelve No. 2 wire drawing machines are located approximately 30 ft. from batch type annealing furnace bases. Only two types of transportation facilities; namely, an industrial truck and a multi-purpose crane, have been provided in this mill.

★ ★ ★

THE fork truck is used to deliver the rod, to remove the scrap and to transfer the skids of wire from the crane area to the intraworks flat car.

★ ★ ★

Fig. 29: View of Kearny mill area serviced by overhead multi-purpose crane

THE crane accomplishes a number of functions. At this plant,

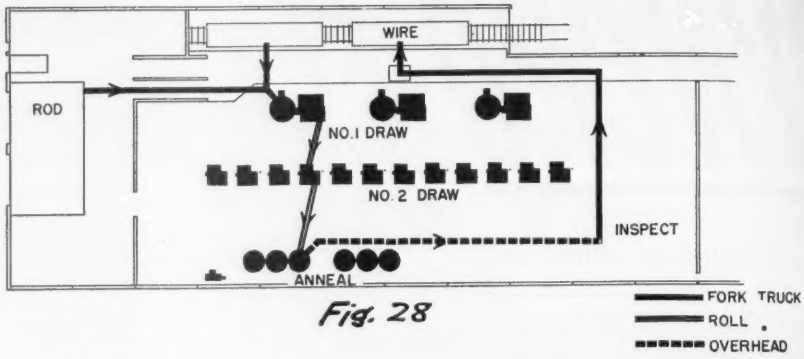


Fig. 28

one operator located in a crane cab, without any assistance, can use specially designed grapples to perform the following operations before and after batch type annealing operations.

★ ★ ★

a. Lift two 400# spools from floor using a solenoid operated chuck grapple and load spools into batch type annealing basket.
b. Move basket containing 5 tons of wire and place on annealing furnace base.
c. Locate gas seal retort or cover over wire basket.
d. Place electric furnace bell over charge of wire to be annealed and later remove the furnace bell. Equipment is designed to make electrical plugging automatic.
e. Locate water cooling ring on retort for cooling charge after annealing.
f. Unload spools from annealing basket into shipping or storing skids.

Fig. 30: Annealing basket being placed by crane on furnace base

Fig. 31: Crane locating furnace bell with automatic plugging equipment

★ ★ ★

One Material Handling Problem

Fig. 32: Single spool being delivered from annealing basket to shipping skid

SEVERAL years ago after this installation was completed it

Fig. 29

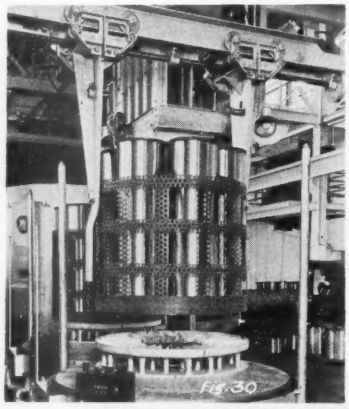


Fig. 30

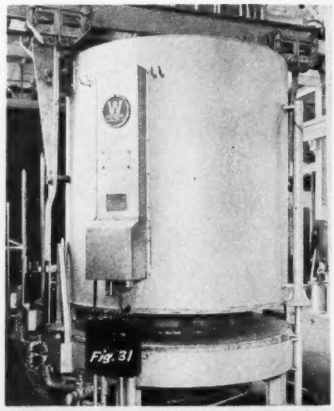


Fig. 31

Fig. 32

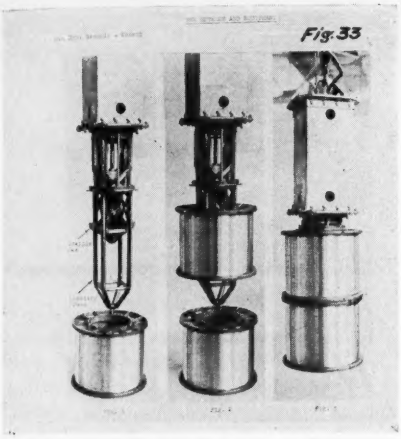


Fig. 34: Supply stands at pulp insulating machines using 400# spools from Western Electric Wire Mills.

was necessary to increase the capacity of this mill to handle a peak load of over 40,000,000 lbs. of wire annually. One of the bottlenecks was the single crane, which at that time was equipped with a solenoid operated chuck grapple for lifting one 400# spool at a time into the batch annealing basket and out of the basket into the shipping skids. Various alternative designs such as auxiliary grapples on floor operated booms or a second crane on the single runway were considered and discarded. Instead a special two spool lifting grapple was designed to reduce the effort of handling a maximum of 1000 reels daily.

★ ★ ★

Fig. 33: Three views of a crane grapple designed to lift two 400# spools

THREE photographs of the steps followed in lifting the two spools are shown. The locating frame which slides up and down freely with respect to the grapple lifting linkage is the key to the new method of handling. As the grapple lifts the first reel, the frame slides through the core and projects below the bottom flange. The reels are centered and the grapple is lowered to engage the second. Where two reels are located together in a basket, the grapple can lift two 400# reels in one operation.

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AS indicated previously only the principal material handling facilities and devices used for the movement and handling of copper rod and wire have been described. The handling of copper oxide scale, drawing compound, copper sludge and scrap, the tonnage of which is small, is equally important. For these operations and at subsequent tinning, enameling or insulating machines, specific material handling methods have been worked out and provided.

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Conclusion

THIS completes our visit to the Western Electric Rod Mill and the Wire Mills at Hawthorne, Tonawanda, Point Breeze and Kearny. At these locations, mechanized methods are being used wherever possible, space has been efficiently utilized and free flow of material has been engineered into the layouts. The objectives have been, and still are, high quality of wire at low cost, with safety to personnel throughout all stages of manufacture. The initial objectives of the personnel associated with wire drawing development which began 30 years ago have been maintained in the new installations.

★ ★ ★

SPECIAL

The following papers were not received in time for publication in this issue. They will be published in the November and December issues of Wire & Wire Products.

PAPER: "Wire Testing and Evaluation of the Usual Tests Applied to Steel Wire"	Lewis R. Steuer Superintendent of Tests Williamsport Plant	Bethlehem Steel Corp. Williamsport, Pa.

CLEANING AND COATING SYMPOSIUM PAPERS

PAPER: "Salt Cleaning of Wire"	H. Clark Smith, Jr.	Wilbur B. Driver Co. Newark, N. J.
PAPER: "Straight Line Cleaning and Coating using Lime or Borax"	R. H. Hertzog	John A. Roebling's Sons Co. Roebling, N. J.
PAPER: "Mechanical Cleaning of Hot Rolled Wire Rod and Bar Stock"	Gilbert D. Dill	American Wheelabrator & Equipment Corp. Mishawaka, Ind.
PAPER: "Phosphate Coatings"	James Leland	Parker Rust Proof Co. Detroit, Mich.
PAPER: "New Coatings for Bolt and Nut Stock Requiring No Lubricant"	W. Hill, Jr.	Russell, Burdsall & Ward Bolt & Nut Co. Portchester, N. Y.

"Prestressed Concrete"

By M. Fornerod, Chief Engineer
The Preload Corporation
New York, New York

This paper describes prestressed concrete which is a relatively new field in Civil Engineering. It is a field in which hard drawn wire is used to an ever increasing extent.

Introduction

FIRST, let me describe to you in elementary terms what prestressed concrete is even though some of you may already be quite familiar with its principle.

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Definition

AS a general definition for prestressing, the following has been suggested: "Prestressing is the application upon a structure or a structural member of artificial external forces and their conversion into internal forces of sufficient magnitude to neutralize permanently undesirable stresses of opposite sign due to load."

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IF this definition is applied to a concrete beam we can readily see how, by the application of an external longitudinal compression force along the lower fibre of the beam the stress distribution in the cross-section of the beam can be changed and controlled. In practice this is done in such a manner as to eliminate all tensile stresses in the concrete in all loading stages.

★ ★ ★

THE prestressing of a beam made of a material without tensile strength has often been compared to the lifting between your two hands of a row of books. If you press hard enough the books will form a beam supporting its own weight plus whatever load is placed on top of it.

★ ★ ★

Comparison with R. C. and Advantages

NOW what is it that prompted engineers to search for a new and better way to design and build concrete structures? You may know that the designer is limited by the unpleasant fact that the concrete in the lower fibre of a beam cannot follow the elongation of the reinforcing steel. Furthermore, the concrete has no appreciable tensile strength and must, therefore, crack already at a time when the stress in the steel has not even reached 10% of its working stress. On the other hand, concrete is well suited to take high compression stresses.

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TODAY economical concrete having a crushing strength of 4,500 psi at 28 days is quite common and at relatively little extra cost strengths of up to 10,000 psi can be obtained. However, such high quality concrete is of no avail in ordinary reinforced concrete design as the use of high concrete stresses would result in very shallow beams in which very large cracks would develop, and which would not even provide sufficient cross-section to embed all the reinforcing steel.

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FOR prestressed concrete we preferably use both high grade concrete and high carbon steel wire reinforcing. The process is roughly as follows:

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Prestressing and Post Stressing

WE take a number of high carbon steel wires and stretch them to a predetermined initial prestress, keep them stretched and then pour concrete around them. After the concrete is hardened we release the wires. Due to their bond with the concrete the shortening of the wires causes compression in the concrete. The concrete is precompressed and the steel is prestressed.

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THE same result can be obtained by first pouring a concrete beam with a longitudinal hole near its lower fibre. Then after hardening we introduce a number of steel wires into this hole, stretch them to a predetermined amount and anchor them at the ends in their stretched condition. The force in the cable is thereby transferred to the concrete which in turn is brought into compression. The hole in the beam is then filled with grout. This latter method is called "post"-stressing.

★ ★ ★

IN both methods, prestressing and post-stressing, the concrete in the lower fibre of a beam is compressed sufficiently to avoid all tensile stresses due to its subsequent loading with live load.

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ANOTHER important feature in prestressed concrete design is the possibility of eliminating diagonal tension stresses in the shear zone of a girder. By raising the prestressing cable toward the ends of the girder we can create a reasonably uniform precompression near the ends which, when

(*Please turn to page* 925)

Processing of Aluminum Alloys with Tungsten Carbide Drawing Dies

By

C. E. Hughes
Southern District Mgr.,

and

E. T. Miller
Supervisor, Wire Die Sales,

Firth Sterling Steel & Carbide Corp., McKeesport, Pa.

Although Aluminum has again become one of the critically short metals, large quantities will still be processed, and this paper, presented before the Wire Association Convention in Baltimore, provides added working data on its various alloys.

ALUMINUM, the youngest of the construction materials, has enjoyed one of the most rapid advances to popularity in history. Evidence of this fact lies in production figures of 100,000 pounds per month 25 years ago to quantities over 50 million pounds per month during the past several years.

★ ★ ★

ONE of the reasons to which this rise in popularity may be attributed is the ease with which the material may be processed. Some of the principal applications for which Aluminum has found its greatest use are electrical conductors, wire screening and construction materials in the aircraft industry, the latter including structural sections, rivets and "skin" material. More recent uses include the building and decorative fields.

★ ★ ★

TO better appreciate the importance of aluminum alloys to modern American industry, a comparison should be made of the physical properties of this material as compared to steel: see Table 1.

★ ★ ★

AS might be expected, the production of aluminum alloys follows closely the processing practices of copper and other nonferrous materials. However, it gradually became apparent certain specific modifications were advantageous to the economical production of aluminum alloys. This became particularly necessary with the development of the high tensile type alloys, which presented problems similar to those encountered when processing alloy steels.

★ ★ ★

SINCE the purpose of the Wire Association deals principally with the cold processing of metallic materials, we will deal very briefly with the preparation of the material for cold finishing.

★ ★ ★

ALUMINUM ingots are successfully produced by the continuous casting, direct chilling process, and present practice employs sections 12″ square or larger. Aluminum alloys are bloomed at temperatures of 800° F. to 900° F. Subsequent to blooming and in cases where special alloys produce a poor surface condition on the ingot, aluminum is conditioned by scalping. This is the first portion of the process that differs materially from standard steel production practice. The purpose of aluminum conditioning is for the removal of laps, cracks and imperfections, as well as the high alloy skin surface and such casting defects as may appear. The operation is performed on large special purpose milling machines equipped with either high speed steel or carbide tipped blades. Scalpers, in some cases, are equipped to machine two sides and two corners of the bloom per pass between the cutters, and metal is removed at such speeds that a continuous chip conveyor is necessary to insure continuous operation of the machine.

★ ★ ★

FROM conditioned blooms, rolling methods and reduction per pass follow closely those used in the steel industry. However, in the cases of some of the special alloys, smaller reductions per pass are necessary, as well as increased power requirements. In aluminum rolling, however, it will be observed that the coherent oxide film does not serve as a lubricant as compared to the oxides formed on copper and steel; and as a result, serious frictional difficulties will occur unless soluble oil or grease and roller guides are employed to keep sliding friction to a minimum.

★ ★ ★

STRONGER aluminum alloys resist deformation to a greater degree than carbon steel and drafting practice on these alloys is more nearly comparable to that used for tool steels. Specific physical properties may be obtained by cold working, aging and heating, or a combination of these processes.

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BEFORE discussing in detail the cold processing of aluminum, it should be noted that hydraulic

TABLE I

	Aluminum	Steel
Tensile	12,000 to 82,000 p.s.i.	50,000 to 300,000 p.s.i.
Yield	6,000 p.s.i. to 50,000 p.s.i.	50,000 to 200,000 p.s.i.
Modulus of Elasticity	10,300,000 p.s.i.	30,000,000 p.s.i.
Weight—Pounds/cu. inch	.096 — .101	.283

extrusion is widely used for the production of intricate shapes, as well as the working of difficult alloys, not adaptable to the rolling process.

★ ★ ★

UP until recently, the dies used in the extrusion process were made from a 5% Chrome hot work die steel. However, recent tests indicate that certain analyses of tantalum and titanium carbides show excellent promise for the hot extrusion of aluminum alloys.

★ ★ ★

SINCE the temperature encountered rarely exceeds 1,000 degrees in the dies, we have had very promising preliminary results with Firthaloy on this application. We feel certain that in the near future, the cost and delivery problem will largely be eliminated through a new process now under development by Firth Sterling. This process produces intricate forms in the final sintered carbide within extremely close tolerances. While the process and present results on hot carbide extrusion dies are not conclusive, they show promise of long production runs with excellent finish and freedom from scratches, in the not too distant future.

★ ★ ★

YOU are all familiar with the collapsible tubes such as used for tooth paste containers. This product is made from aluminum rod sized through a carbide die, cut to length with a carbide knife and quill, and inserted in a carbide chamber die. The punch, of slightly smaller diameter than the chamber, is then forced into the die, causing the aluminum to extrude up around the punch. This operation is done cold and the resulting tube is then stripped from the punch.

★ ★ ★

RECENTLY, extremely intricate forms have been produced by this method, known as impact extrusion. Future expansion of this process and the increased use of carbide chamber dies with their lower frictional characteristics will result in longer tubes and will permit more complicated sections to be produced.

★ ★ ★

THERE is a slight change in carbide die design over conventional steel dies, inasmuch as a sharp corner is employed in the entrance angle of the carbide nib rather than a radius.

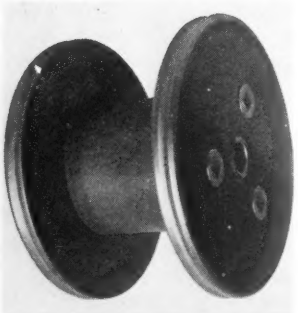
★ ★ ★

THE inherent ability of certain aluminum and aluminum alloys to produce a combination of strength and stiffness and withstand deformation also permits the use of Cold Heading. Here carbide die design is very similar to that used for cold heading other materials, but resultant die life is much greater in heading aluminum. A typical example of the production possible with carbide dies is the case of aluminum versus steel rivets. Production of three million 1/8" steel rivets per die is worthy of attention, while twenty million aluminum rivets are expected, rather than hoped for.

★ ★ ★

(*Please turn to page* 902)

Most Important Advance in Reel Construction in 20 Years — the



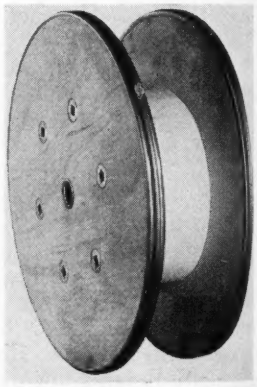
"PRESSURE PAD FASTENER"***

USED ON ALL

HOWSAM MAGNET WIRE REELS and SHIPPING SPOOLS and REELS

* Reg. Trade Name

** Patent Pending



"Pressure Pad Tightening" requires only one tool and is a one-man job. So constructed that only 20% require tightening upon return. This means that the average reel needs tightening but once in 5 trips between your customer's and your plant. Also, seals joints tight so no moisture can get in around the bolts. Write for details.

'PHONE: 2-3043

HOWSAM SPOOL COMPANY

AURORA, ILLINOIS

PROGRAM

Annual Convention of The Wire Association

Lord Baltimore Hotel, Baltimore, Md., October 23-26, 1950

Wire Association Headquarters at the Lord Baltimore Hotel
Will be Open from Monday, October 23, Every Evening During the Convention
Come and Get Acquainted!

THERE WILL BE A REGISTRATION FEE OF $5.00 FOR THOSE ATTENDING THE TECHNICAL SESSIONS AND INFORMAL MEETINGS.

ADMISSION WILL BE BY BADGE ONLY — PLEASE WEAR IT

Discussions Will Be Held on the Papers Presented and These Discussions Will Be Published in the January, 1951, Issue of Wire and Wire Products

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Lord Baltimore Hotel, Baltimore, Md., Oct. 23-26, 1950

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Sales Promotion
Firth-Sterling Steel & Carbide Corp.
McKeesport, Pa.

All wire mill men and suppliers are invited to attend this meeting, see how the Association functions and participate in the activities.

GENERAL ACTIVITIES

Richard E. Brown, Executive Secretary
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300 Main Street
Stamford, Conn.

Papers selected are preprinted in Wire and Wire Products October 1950 issue in advance of the meeting. Title to papers accepted will be given the Wire Association and duly copyrighted at time of publication. All papers are eligible for consideration for the Annual Medal Award.

★ ★ ★

ANNUAL LUNCHEON

Mrs. R. S. Spengel, Sec.-Treas.
Wire and Wire Products
Stamford, Conn.

All wire mill men and suppliers are invited to attend this meeting, see how the Association functions and participate in the activities.

Hotel reservations should be made by members of the Wire Association direct to the Secretary.
MAKE YOUR PLANS NOW TO ATTEND AND SEND YOUR RESERVATION PROMPTLY

MONDAY, OCTOBER 23

9:00 A. M.	10:30 A. M.	12:30 P. M.
REGISTRATION	DIRECTORS' MEETING	PROGRAM COMMITTEE LUNCHEON

— The Technical Sessions —

Lord Baltimore Hotel, Baltimore, Md., October 23-26, 1950

MONDAY, OCTOBER 23

Afternoon Session — 2 P. M.

Address of Welcome by Fred M. Crapo, President, Wire Association

Norman T. Nelson, Production Engineer, Chairman of Meeting — Bethlehem Steel Co., Sparrows Point, Md.

PAPER: "Material Handling at the Rod and Wire Mills of the Western Electric Company" — J. E. Wiltrakis, Assistant Superintendent, Factory Planning; and A. A. Bureau, Department Chief, Material Handling — Western Electric Co., Kearny, N. J. / Western Electric Co., Hawthorne Works, Chicago, Ill.

PAPER: "A New Method of Storing Rod" — A. F. Anjeskey, Sales Manager — Cleveland Tramrail Div., Cleveland Crane & Engineering Co., Wickliffe, Ohio

FILM ON STEEL MAKING — "Fifteen Minutes With Bethlehem." This will serve as a preview for the inspection trip on Thursday.

TUESDAY, OCTOBER 24

Morning Session — 9:30 A. M.

FERROUS SECTION

Robert Peterson, Production Manager, Chairman of Meeting — Thompson Wire Co., Worcester, Mass.

PAPER: "The Use of High Carbon Wire In Pre-Stressing Concrete" — H. Fornerod — The Preload Corp., New York, N. Y.

PAPER: "Wire Testing and Evaluation of the Usual Tests Applied to Steel Wire" — Lewis R. Steuer, Superintendent of Tests, Williamsport Plant — Bethlehem Steel Corp., Williamsport, Pa.

NON-FERROUS SECTION

Sidney Rolle, Assistant Manager, Chairman of Meeting — The Scomet Co., New York, N. Y.

PAPER: "Aluminum Rod and Tube Production, Drawing and Extruding" — Charles E. Hughes, Sales Engineer — Firth-Sterling Steel & Carbide Corp., McKeesport, Pa.

PAPER: "The Production and Application of Copper Base Alloy Wire" — W. D. France and Wayne Johnson and W. L. Wells — Scovill Manufacturing Co., Waterbury, Conn.

TUESDAY, OCTOBER 24

Afternoon Session — 2 P. M.

FERROUS SECTION

R. S. Worth, Manufacturing Manager, Wire Mills Div., Chairman of Meeting — John A. Roebling's Sons Co., Roebling, N. J.

CLEANING AND COATING SYMPOSIUM

PAPER: "Salt Cleaning of Wire" — H. Clark Smith, Jr. — Wilbur B. Driver Co., Newark, N. J.

PAPER: "Straight Line Cleaning and Coating using Lime or Borax" — R. H. Hertzog — John A. Roebling's Sons Co., Roebling, N. J.

PAPER: "Mechanical Cleaning of Hot Rolled Wire Rod and Bar Stock" — Gilbert D. Dill — American Wheelabrator & Equipment Corp., Mishawaka, Ind.

PAPER: "Phosphate Coatings" — James Leland — Parker Rust Proof Co., Detroit, Mich.

PAPER: "New Coatings for Bolt and Nut Stock Requiring No Lubricant" — W. Hill, Jr. — Russell, Burdsall & Ward Bolt & Nut Co., Portchester, N. Y.

Afternoon Session — 2 P. M.

NON-FERROUS SECTION

Plant Inspection Trip—Point Breeze Plant—Western Electric Co. — For Non-Ferrous Members —

— The Technical Sessions —

Lord Baltimore Hotel, Baltimore, Md., October 23-26, 1950

WEDNESDAY, OCTOBER 25

Morning Session — 10:00 A. M.

FERROUS SECTION

Tom Girdler, Jr.
Superintendent
Beaver Falls Plant
Chairman of Meeting

Union Drawn Steel Div.
Republic Steel Corp.
Beaver Falls, Pa.

PAPER:

"The Role of Mill Service Men to Fabricators of Wire Products"

Kenneth Findlay
Metallurgist

Allegheny Ludlum Steel Corp.
Dunkirk, N. Y.

PAPER:

"Wire for Welding Electrodes"

James Claussen
and
H. E. Sincock

Reid-Avery Co.
Dundalk, Md.

NON-FERROUS SECTION

Sidney Rolle
Assistant Manager
Chairman of Meeting

The Scomet Co.
New York, N. Y.

PAPER:

"Neoprene Jacketed Telephone Wires"

C. C. Lawson
Wire Development Engineer

Bell Telephone Laboratories
Murray Hill, New Jersey

PAPER:

"The Gas Compression Cable"

Kenneth S. Wyatt
Cable Engineer

Phelps Dodge Copper Products Co.
New York, N. Y.

WEDNESDAY, OCTOBER 25

1:00 P. M.

WIRE ASSOCIATION LUNCHEON

THE MORDICA MEMORIAL LECTURE

J. L. Schueler
General Superintendent
Continental Steel Corp.
Kokomo, Ind.

Title: "Design and Manufacture of Woven Wire Fence"

— Presentation of the Wire Association Medal Award for 1949 —
To John H. Corson, Metallurgist, John A. Roebling's Sons Co., Roebling, N. J.

Title: "Welding in the Wire Industry"

LADIES ARE CORDIALLY INVITED TO ATTEND

LADIES ARE CORDIALLY INVITED TO ATTEND

WEDNESDAY, OCTOBER 25

Annual Meeting of the Wire Association
Fred M. Crapo, President
Chairman of Meeting

Immediately Following The Luncheon

WEDNESDAY, OCTOBER 25

6:30 P. M.

ANNUAL DINNER-SMOKER

N. W. deBerardinis, Manager
Sales Promotion
Firth-Sterling Steel & Carbide Corp.
McKeesport, Pa.

THURSDAY, OCTOBER 26

10:30 A. M.

INSPECTION OF ROD AND WIRE MILL

Bethlehem Steel Co.
Sparrows Point, Md.

Busses Leave Hotel at 10:30 A. M.

Steamer Latrobe will leave Baltimore at 11 o'clock for inspection of historic Baltimore Harbor before proceeding down the bay to Sparrows Point.

Box lunch will be served enroute.

Boat will dock at Sparrows Point at 1:30 where busses will be waiting to transport visitors through the steel plant and to the Rod and Wire Mill.

Upon completion of inspection, busses will be waiting to transport members and guests back to Baltimore. Ladies Are Invited.

LADIES ARE INVITED.

RESEARCH PAPERS ARE PREPRINTED IN THE OCTOBER ISSUE OF WIRE AND WIRE PRODUCTS
The Discussions and the Mordica Memorial Lecture will be printed in the January 1951, issue of Wire and Wire Products

Papers not received in time for preprinting will be published in the November and December issues of Wire and Wire Products.

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FRED M. CRAPO
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Indiana Steel & Wire Co.
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St. Louis, Missouri

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★ ★ ★

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Republic Steel Corp.
Massillon, Ohio

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Sheffield Steel Corp.,
Sand Springs, Okla.

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Dominion Works
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Montreal, Canada

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Box 1714, Atlanta 1, Ga.

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Nehring Electrical Works,
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Ralph K. Clifford, President,
Continental Steel Corp., Kokomo, Ind.

J. K. Beeson, Director,
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Carl E. Johnson, Supt., Rod & Wire Mills
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J. R. Thompson, Manager, Met. Dept.,
American Steel & Wire Co.,
Cleveland, Ohio

Curtis Voigtlander, Superintendent,
Wire Mills, Union Wire Rope Company,
Kansas City, Mo.

★ ★ ★

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Jones & Laughlin Steel Corp.,
Pittsburgh, Pa.

Leroy D. Seymour, Vice President,
Marshall-Richards Machine Co., Inc.,
Trenton, N. J.

THE Wire Association is a non-profit organization of wire mill executives, superintendents and foremen. It also includes plant engineers, traffic men, and all others engaged in the production of cold drawn bars, rods, wire, strip, insulated wire and cable, and the manufacture and fabrication of finished wire products, including cold headed, extruded and other cold worked metal products.

THERE are separate divisions for all the separate major interests in the wire industry, steel, iron, brass, copper, alloy, and precious metals, together with divisions relating to drawing, cold working, cold heading, extruding, fabricating, forming, spring making, wire cloth, wire rope, bare and covered electric wire and cable and all other forms of wire and wire products.

★ ★ ★

PURPOSES

ITS specific purpose is to improve production methods and afford a clearing house for ideas on management problems, technical problems, and research work in all phases of practical wire drawing and wire working, and to develop and maintain friendly relations among the members.

★ ★ ★

ACTIVITIES

The Association functions along the following lines:

1. The use of the Association headquarters as a central clearing house for information and data of all kinds which may be of interest to members.
2. The exchange of ideas on processes of production including machinery, technical processes, etc.
3. The establishment and maintenance of friendly relations among the members of the association and the development of sectional and national meetings to discuss matters of mutual interest.
4. Studies of production methods and analysis of production costs.
5. Developments in the use of new materials and new applications of existing materials and by-products.
6. Research and collection of information on personnel management, including such factors as labor turnover, seasonal changes in the demand for employees, wage scales, etc.
7. Standardization and simplification as a means for the effective elimination of waste.
8. Such other subjects as may be determined upon.

THE WIRE ASSOCIATION MEDAL AWARDS

For the Most Meritorious Paper on Wire Manufacture or Fabrication During the Year
— BY A MEMBER OF THE WIRE ASSOCIATION —

MEDAL AWARDS

1934 — EDWARD J. P. FISHER
Metallurgist, Keystone Steel & Wire Co., Peoria, Ill.
Title of Paper: "COLD DRAWN STEEL SPRING WIRE"

1935 — BENJAMIN LEWIS McCARTHY
Metallurgist, Wickwire Spencer Steel Co., Buffalo, N. Y.
Title of Paper: "GRAIN SIZE AND ITS INFLUENCE ON THE MANUFACTURE OF STEEL WIRE"

1936— ROBERT NOTVEST
Chief Engineer, Welding Division, J. D. Adams Mfg. Co., Indianapolis, Ind.
Title of Paper: "STEEL FOR ARC WELDING ELECTRODES"

1937 — BENJAMIN LEWIS McCARTHY
Chief Metallurgist, Wickwire Spencer Steel Co., Buffalo, N. Y.
Title of Paper:
"ABNORMAL GRAIN GROWTH AND THE ANNEALING OF LOW CARBON STEEL WIRE"

1938 — WALTER R. BLOXDORF
Metallurgist, The MacWhyte Co., Kenosha, Wis.
Title of Paper: "WIRE ROPE"

1939 — STANLEY P. WATKINS
Manager, Sales Development, Rustless Iron and Steel Corp. Baltimore, Maryland
Title of Paper:
"THE MANUFACTURE AND USE OF STAINLESS STEEL WIRE"

1940— ROBERT W. SANDELIN
Metallurgist, Atlantic Steel Company, Atlanta, Georgia
Title of Paper:
"GALVANIZING CHARACTERISTICS OF DIFFERENT TYPES OF STEEL"

1941 — CARLETON W. GARRETT
Wire Mill Metallurgist, Jones & Laughlin Steel Corp. Aliquippa, Pennsylvania
Title of Paper:
"A BRIEF DISCUSSION ON THE MANUFACTURE OF STEEL FOR ARC WELDING ELECTRODES"

1942 — LE ROY DEVOE SEYMOUR
Asst. Works Manager, Canada Works, Steel Company of Canada, Ltd., Hamilton, Ontario, Canada
Title of Paper:
"SCHEDULING AND PLANNING THE WIRE MILL FOR WAR PRODUCTION"

1943 — JOHN C. AIKEN
Asst. Supt., Rod and Wire Mills, Jones & Laughlin Steel Corp., Aliquippa, Pennsylvania
Title of Paper: "DRAWING HIGH SPEED ROPE WIRE"

1944 — AUGUST R. ZAPP
Manager, Carbide Division, Firth-Sterling Steel Company, McKeesport, Pa.
Title of Paper:
"HISTORY AND GROWTH OF THE TUNGSTEN CARBIDE DIE"

1945 — MATTHEW J. DONACHIE
Technical Director of Production, Beryllium Corporation, Reading, Pa.
Title of Paper:
"SOME TRAITS AND CHARACTERISTICS IN THE WORKING OF BERYLLIUM—COPPER WIRE"

1946-1947—No awards

1948 — REGINALD S. BROWN
Chief Metallurgist, Rylands Brothers, Ltd. Warrington, England
Title of Paper: "WEAR RESISTANCE OF WIRE FOR ROPE WIRE"

1949 — JOHN H. CORSON
Metallurgist, John A. Roebling's Sons Co. Roebling, N. J.
Title of Paper: "WELDING IN THE WIRE INDUSTRY"

HONORABLE MENTIONS

1935 — L. D. SEYMOUR
Metallurgist, Rod and Wire Dept., Youngstown Sheet & Tube Co., Youngstown, Ohio
Title of Paper: "COLD HEADING WIRE"

1935 — R. A. SCHATZEL
Superintendent, General Research Laboratories, General Cable Corp., Rome, N. Y.
Title of Paper: "HARD AND SOFT COPPER WIRE"

1936 — BENJAMIN LEWIS McCARTHY
Metallurgist, Wickwire Spencer Steel Co., Buffalo, N. Y.
Title of Paper: "PLASTIC DEFORMATION IN WIRE DRAWING"

1937—ROBERT W. SANDELIN
Metallurgist, Atlantic Steel Co., Atlanta, Ga.
Title of Paper:
"A METALLURGICAL STUDY OF THE FACTORS AFFECTING THE QUALITY OF GALVANIZING"

1937 — ALAN B. DOVE
Chemical Engineer, Canada Works, The Steel Company of Canada, Ltd., Hamilton, Ont., Canada
Title of Paper:
"A. C. ELECTRO PICKLING—A BETTER METHOD OF PICKLING"

1938 — RODMAN R. TATNALL
Metallurgist, Morgan Works, Spencer Steel Co. Worcester, Massachusetts
Title of Paper: "RESILIENCE OF SPRINGS"

1939 — JOSEPH A. DOYLE
Vice President, W. S. Rockwell Co., New York, N. Y.
Title of Paper: "HEATING COPPER WIRE BARS"

1940—H. BLOUNT and J. D. WILTRAKIS
Mfg. Engineer, Point Breeze Works, Engineer, Kearny Works, Western Electric Company
Title of Paper:
"DESIGN AND OPERATION OF A NEW COPPER WIRE DRAWING PLANT"

1941 — RODMAN R. TATNALL
Metallurgist, Morgan Works, Wickwire Spencer Steel Co., Worcester, Massachusetts
Title of Paper:
"TIME, TEMPERATURE AND SIZE IN THE HEATING OF STEEL WIRE"

1942—COLONEL FRANK W. BULLOCK
Signal Corps, United States Army
Title of Paper: "THE WIRE INDUSTRY IN WAR"

1943 — E. J. CRUM
General Foreman, Bethanizing and Galvanizing Departments, Bethlehem Steel Company, Sparrows Point, Md.
Title of Paper:
"THE GRAPHICAL SOLUTION OF WIRE MILL MATHEMATICAL PROBLEMS"

1944 —FERNALD S. STICKNEY
Vice President and Chief Engineer, Instrument Specialties Company, Little Falls, N. Y.
Title of Paper: "MAKING 'SPRING-GRADE' BERYLLIUM COPPER WIRE"

1945 — RALPH C. ELLAMS
Supervisor, Electrical Coating Development Roxalin Flexible Finishes, Inc., Elizabeth, N. J.
Title of Paper:
"SUCCESSFUL FINISHING OF ELECTRICALLY INSULATED WIRE AND CABLE"

1945—D. A. SUTCH, Metallurgist, and B. L. McCARTHY, Chief Metallurgist, Wickwire Spencer Steel Co., Buffalo, N. Y.
Title of Paper:
"REDUCTION OF AREA VALUES AS A GUIDE TO PATENTING"

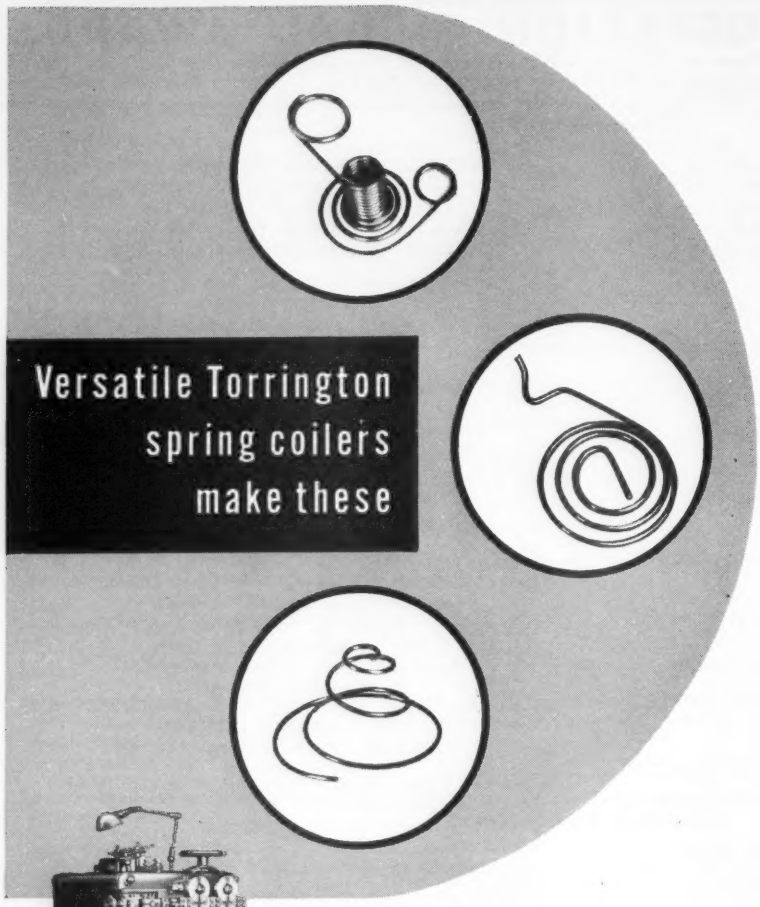
1946 - 1947 — No awards

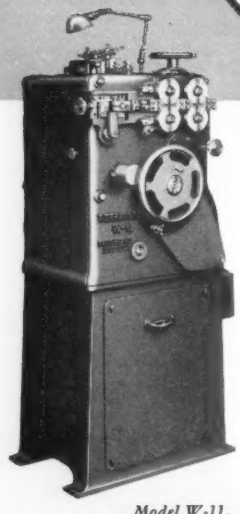
1948 — C. A. ZAPFFE, Consulting Metallurgist and M. E. HASLAM, Research Chemist Baltimore, Md.
Title of Paper:
"EVALUATION OF PICKLING INHIBITORS FROM THE STANDPOINT OF HYDROGEN EMBRITTLEMENT"

1948—CHRISTIAN WITTEVELD
Process and Development Engineer, Bridgeport Brass Company, Bridgeport, Conn.
Title of Paper: "BRASS WIRE PROCESSING"

1949—H. J. GODFREY, Development Engineer and DARTLEY LEWIS, Chief Development Engineer John A. Roebling's Sons Co., Roebling, N. J.
Title of Paper: "BACK PULL WIRE DRAWING"

1949—E. G. deCORIOLIS, Director of Research and O. E. CULLEN, Chief Metallurgist Surface Combustion Corp., Toledo, Ohio
Title of Paper: "PROTECTIVE ATMOSPHERES FOR ANNEALING NON-FERROUS WIRES"





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SPECIFICATIONS

Wire Diameter Range: .015" to .072"

Wire Length per Spring: 0" to 42" (Extra Wire Feed Gears Available)

Coil Range (O.D.): 3/32" to 1-9/16"

Production: 23 to 190 springs per minute with variable speed drive

Torsion and other attachments available.

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Government Wire Production Information

Creep of Annealed High-Purity Copper

CREEP tests were recently made by W. D. Jenkins and T. G. Digges of the National Bureau of Standards on annealed oxygen-free high-conductivity copper (OFHC) as part of a continuing investigation of the properties of copper and nickel and their alloys at elevated temperatures. The completed portion of the program includes a study of the effects on creep behavior of stress, temperature, mechanical and thermal history, rate of loading, and sudden changes in both stress and temperature. All creep tests were made in tension under constant load conditions at temperatures of 110°, 250° and 300°F. Metallographic examination, hardness measurements, and tension tests were conducted at room temperature on specimens representative of the copper as annealed and after testing into various stages of creep.[1]

★ ★ ★

THE general relation between extension and time during creep of metals and alloys tested in tension at a constant load and a constant temperature can be simply represented by an extension-time curve. For ideal conditions, the course of such a curve is divided into parts as follows: (1) An initial extension (elastic and plastic) which occurs on the application of the load; (2) a stage of decreasing rate of extension (designated as primary or first stage of creep); (3) a stage of nearly constant rate which attains a minimum (designated as secondary, minimum rate or second stage of creep); and (4) a stage of increasing rate eventually leading to complete fracture (designated as tertiary or third stage of creep).

★ ★ ★

A SOURCE of concern to analysts of creep data has been their inability to reconcile the re-

[1]For further technical details, see "Creep of High Purity Copper," by W. D. Jenkins and T. G. Digges NBS Journal of Research, August 1950 issue, Vol. 45, RP 2121.

lations between strain hardening and recovery and the change in structure that occur during the different stages of creep on the basis of a continuous, smooth extension-time curve. A consideration of the mechanism of the changes that occur during creep suggests that there should be discontinuities in the course of this curve. That is, there should be a delay in time while relaxation proceeds until sufficient stress is concentrated in other regions to initiate flow in these regions. The delay in the periods of time during which the test specimen undergoes no appreciable extension or actually contracts (negative creep) should be of sufficient magnitude to be readily detected in precision testing. Such discontinuities in the extension-time curves were observed in previous creep tests made on ingot iron (strain aging material) and in some of the present tests on high-purity copper.

★ ★ ★

THE prominence of the discontinuities in the extension-time relationship varied not only with the test conditions (temperature, stress, etc.) but also with the progress of the test. They were more prominent in the second stage of creep than in either the first or third stage. Furthermore, during the course of the creep test apparently the structure was continually changing, in that the parent grains broke down into subcrystals, some of which were of microscopic dimensions. The extent to which the substructure was formed also varied with the test conditions. The trend was for the size of these secondary crystals to increase with an increase in temperature and with a decrease in strain rate. However, strain markings were evident in all specimens carried to complete fracture in creep, and "twins" were observed in some of the crystals.

★ ★ ★

THE formation of cracks of microscopic dimensions often accompanied but was not necessarily a prerequisite for the initiation of

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● *Shapes*
Square—Keystone—Flat-Round—Half-Round—Special Shapes—Straightened and cut.

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Liquor Finish—Bright Galvanized—Coppered—Enameled All Colors—Annealed—Tinned—Oil Tempered.

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Aircraft	Cable	Hair Pin	Reed
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Bee	Clock Spring	Heddle	Safety Pin
Belt Hooks	Cotter Pins	Hooks and Eyes	Spark Coil Core
Bobby Pins	Curtain Springs	Link Fabrics	Special Springs
Bonnets	Drapery Pin	Lock Springs	Spiral Binding
Bookbinders	Fish Hook	Mattresses	Stapling
Bottlecap	Fish Tape	Needle	Stitching
Box Stitching	Florist	Picture Cord	Umbrella
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● **Corrosion resistant** ● **Extra strength**
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KEYSTONE'S GALVANIZED MB WIRE offers improved corrosion resistance . . . gives added life and strength to mechanical springs subject to rust and corrosive conditions.

This is due to Keystone's unique method of galvanizing the wire *before* it is cold-drawn. The drawing process smooths and hardens the galvanized finish, increasing its lasting qualities remarkably. Other advantages are its lustre-bright, shiny smooth finish . . . even, uniform temper . . . and high tensile strength.

Keystone is prepared to help solve any of your industrial wire problems. If special treatment is called for, Keystone's metallurgical research and testing facilities are available to supply the answers. We welcome your inquiry.

KEYSTONE
STEEL & WIRE CO.
SPECIAL ANALYSIS WIRE SETTING NEW STANDARDS OF PERFORMANCE
PEORIA ILLINOIS

the third stage of creep in the high-purity copper. The positions at which these cracks were nucleated and their subsequent growth were affected by the test temperatures and strain rates. In some cases the cracks were initiated at or near the axis of the test specimen, whereas in other specimens cracking commenced at the surface.

★ ★ ★

Bibliography of Technical Reports

A SUBJECT index to technological documents issued in Volume 12 of the **Bibliography of Technical Reports** is now available to the public, the Office of Technical Services of the U. S. Department of Commerce has announced.

★ ★ ★

THE new index enables researchers to locate reports on any subject carried by the **Bibliography** in the period July-December 1949. Subject headings are comprehensive and include trade names where appropriate.

★ ★ ★

COPIES of the Index may be purchased from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C., at $1 per copy. Check or money order should be made payable to the Treasurer of the United States.

★ ★ ★

INDEXES to Volumes 10 or 11 may be purchased from the O. T. S. at $1 each.

★ ★ ★

THE **Bibliography of Technical Reports,** issued monthly, lists additions to the O. T. S. collection of foreign and domestic technical reports. The collection now totals some 150,000 items. Information on the contents of the collection in any particular field may be secured by writing to the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

★ ★ ★

Advantages of Carbide Industry's New Standard Round Dies

By E. T. Miller, Supervisor, Die Sales
Firth Sterling Steel & Carbide
Corporation, McKeesport, Pa.

SINCE 1945, research conducted by certain manufacturers working closely with the wire mill operators has paved the way to certain die standards which were recommended for industry-wide acceptance by the Carbide Industry Standardization Committee, and announced in October, 1949.

★ ★ ★

CHIEF among the advantages of the new design standards was the inclusion of the back relief in all wire drawing nibs and dies from R-1 with .015 cored hole through R-6. The preformed back relief is a time and money saver for the buyer, since little or no finishing work on the back relief is required in the buyer's die shop.

★ ★ ★

WIRE mill operators found that a back relief was necessary in a drawing die to eliminate the chipping of the carbide on the exit side of the die. The chipped carbide produced wild wire or scratches in the wire. In a fast running machine, a lot of scrap wire could be produced before an operator discovered the damaged die and stopped the machine.

★ ★ ★

THE preformed back relief also permits the wire to back up easily in the die when the drawing machine is stopped. Without a back relief, the sharp edge of the carbide nib shaves the wire, and when the machine is started again, the ragged wire damages the working surfaces in all the successive dies of the string. The preformed back relief in all dies is the wire mill operator's assurance that few dies without back relief will inadvertently be placed in the drawing machines.

★ ★ ★

ANOTHER advantage of the new standard design is that

NEP
The ECONOMICAL INHIBITOR

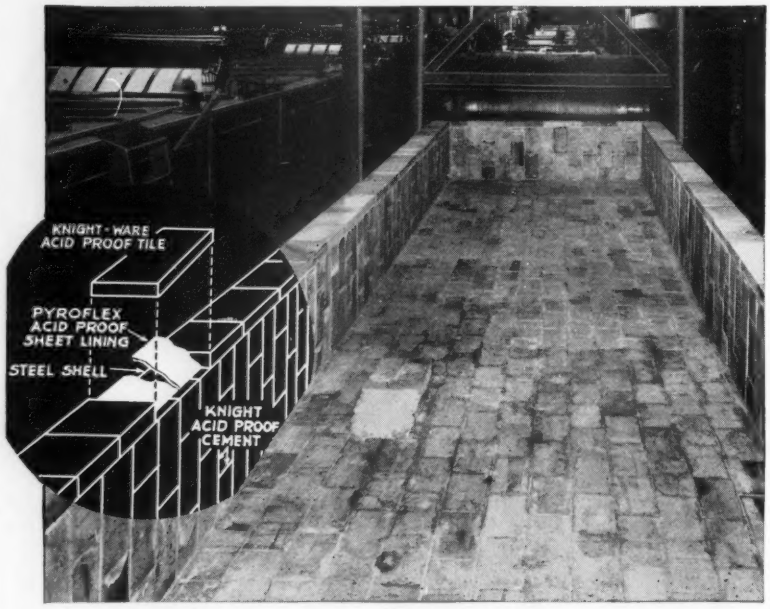
What did one Superintendent say to the other Superintendent:

Dear Ed:
The Parkin Brothers asked me to tell you of our experience with the use of Nep Inhibitor in our pickle lines.
We now have been using the Nep in all three lines since January 1st, 1950, and we have had considerable savings in acid. Our net savings for the first four months of 1950 was - $2,369.56. If this was all due to inhibitor it is really worth while.
We are using about one pint per 1500 lbs. of acid added. We also feel we are getting a slightly whiter steel. We have not reduced the speed of pickling.
Because of the above experience, we have ordered enough to run longer to further check savings.
Yours very truly,

Yes, they're good because we have spent years making them so. Use NEP, NEPTUNE (acid accelerator) and SUM-FOAM (foam fume control) for complete, efficient pickling controls.

THE PARKIN CHEMICAL CO.
HIGHLAND BLDG. PITTSBURGH 6, PA.

* Name upon request.



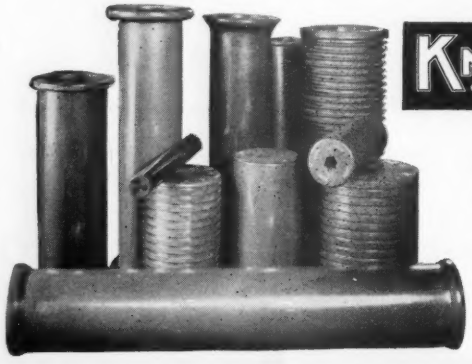
PYROFLEX-Constructed Pickling Tank in Continuous Strip Steel Line.

Corrosion-Proof Rolls and Processing Tanks

Knight-Ware corrosion-proof wire and sheet rolls or sinkers are made to meet customers' needs. You can choose the diameter, groove spacing and length to fit your operation. They are entirely acid-proof and hard with no coating or shell to depend on for acid resistance or wear.

Pickling and plating tanks which are acid-, alkali- and leak-proof are available of Pyroflex Construction. These are steel tanks lined with suitable corrosion-proof materials to best meet your particular operating conditions.

Knight engineers welcome your inquiries on wire rolls and Pyroflex processing tanks. Be sure to give them as complete data as possible regarding the character and purpose for which this equipment is to be used.



KNIGHT-WARE
CHEMICAL EQUIPMENT

MAURICE A. KNIGHT
44 Kelly Ave., Akron 9, Ohio

Knight-Ware Wire and Sheet Rolls or Sinkers Are Made to Fit Your Operations.

the bearing and other working surface of the die is moved up farther in the nib where the drawing stresses are more uniformly distributed throughout the nib and steel casing.

★ ★ ★

THE new nib height permitted the redesign of the interior contour, so that a minimum amount of work is required on the bell and entrance angle as the die is recut to larger hole sizes. The higher nib also provides ample length of entrance angle at the maximum hole size to permit normal drafting practice without crowding the entering wire.

★ ★ ★

PERHAPS the most important of the new design standards to the producers of 16 gage SWG, 13 gage SWG and 11 gage B&S wire is the rough cored hole size change in R-2 and R-3 nibs. It is now possible to obtain rough cored hole sizes closer to the finish-hole sizes most generally used without excessive ripping. For example, .062 or 16-gage wire is a very popular size made in most wire mills. Prior to the adoption of the new standards, it was necessary to buy .040 rough cored dies and rip out nearly .020 and finish to .062. Ripping through excessive stock of sintered carbide is time-consuming and costly. To finish a die to .062 now, the operator can obtain standard nibs with rough cored hole sizes of .055. Furthermore, with the new .055 hole size, it is only necessary to polish the entrance angle on the semi-automatic polisher and open the bearing to size.

★ ★ ★

FOR producers of wire sizes 13 gage SWG (.0915 and 11 gage B&S (.0907) and for 3/32″ steel, a rough cored hole size of .085 is obtainable as standard in die or nib sizes R-4, R-5 and R-6. Previously, the operator had to obtain rough cored hole sizes at .065 to finish dies for the wire sizes mentioned.

★ ★ ★

OF course, the different manufacturers offer a variety of

well-founded arguments as to die construction and casing design. The most important factor in all the carbide die standards, however, is that the new nib standards are based on "greatest economy" for the operator with regard to die finishing for modern wire mill drafting practice.

★ ★ ★

Modern Dry (Gas) Cyaniding Methods Described in New Literature

TO present latest developments in the modern dry (gas) cyaniding process, **Surface Combustion Corporation** has just issued a new bulletin presenting the latest equipment and its applications for this field. This new bulletin is intended to bring metallurgists and heat treaters up to date on the developments which have taken place in the dry cyaniding process since it was first announced in 1945.

★ ★ ★

THE new Surface Combustion bulletin (SC-145) presents a comprehensive story on the application of the dry cyaniding process. Both liquid quenching and slow cooling and their applications are described. Modern equipment and typical installations utilizing both continuous and batch-type equipment for large scale and limited production are presented.

★ ★ ★

THE engineering applications of the dry cyaniding process to various products are described in detail.

★ ★ ★

COPIES of the bulletin (SC-145) can be obtained by writing to Surface Combustion Corporation, Toledo 1, Ohio.

★ ★ ★

AD THOUGHT

May we suggest that reading the ads be made a regular habit. And when you write to an advertiser for information, it helps us and identifies your inquiry to say you saw the ad in WIRE AND WIRE PRODUCTS. Will you do this?

Clip this Chart for Reference

CHEMICALS ACP PROCESSES **SPECIFICATION CHEMICALS** CHEMICALS ACP PROCESSES

FOR THE GOVERNMENT AND ITS CONTRACTORS

Phosphatizing, Rust Proofing and Paint Bonding Chemicals

SPECIFICATION NUMBER	ACP SPECIFICATION CHEMICAL
QQ-P-416	"Lithoform"
	"Zinodine"
RR-C-82	"Lithoform" No. 32
MIL-C-5541 (See also QPL-5541-1)	"Alodine"
MIL-S-5002	"Alodine"
	"Granodine" (Dip, Spray and Brush grades)
JAN-C-490, Grade I	"Granodine" (Dip, Spray and Brush grades)
JAN-F-495	"Granodine" (Dip, Spray and Brush grades)
	"Lithoform"
JAN-L-548	"Permadine"
AN-E-19	"Alodine"
	"Zinodine"
AN-F-20	"Alodine"
	"Granodine" (Dip, Spray and Brush grades)
	"Lithoform"
	"Permadine"
	"Thermoil-Granodine"
	"Zinodine"
	(See also U.S.A. 3-213)
U.S.A. 57-0-2	
Type II, Class A	"Thermoil-Granodine"
Type II, Class B	"Permadine"
Type II, Class C	"Granodine" (Dip, Spray and Brush grades)
U.S.A. 51-70-1	
Finish 22.02, Class A	"Thermoil-Granodine"
Finish 22.02, Class B	"Permadine"
Finish 22.02, Class C	"Granodine" (Dip, Spray and Brush grades)
U.S.A. 50-60-1	"Granodine" (Dip, Spray and Brush grades)
U.S. Navord O.S.675	"Alodine"
U.S.N. Appendix 6	"Lithoform"
Navy Aeronautical M-364	"Permadine"
	"Thermoil-Granodine"
AN-C-170	(See MIL-C-5541)
U.S.A. 72-53	(See AN-F-20)
AXS-1245	(See JAN-C-490)

Rust Removing and Metal Conditioning Chemicals

SPECIFICATION NUMBER	ACP SPECIFICATION CHEMICAL
JAN-C-490, Grade II	
Type 4	"Deoxidine" Nos. 126, 512, 526, 624, 670
Type 5	"Deoxidine" Nos. 170, 171, 670
U.S.A. 3-213	
Type I	"Deoxidine" (Wash-off grades)
Type II	"Deoxidine" (Wipe-off grades)

Metal Cleaning Chemicals

SPECIFICATION NUMBER	ACP SPECIFICATION CHEMICAL
JAN-C-490, Grade II	
Type 2	"Ridoline"
Type 6	"Ridosol"
U.S.A. 3-192	"Ridoline" No. 3192
U.S.N. Appendix 6	"Deoxidine"

Acid Inhibitors, Pickling

SPECIFICATION NUMBER	ACP SPECIFICATION CHEMICAL
U.S.N. 51-1-2	"Rodine"

Write us for descriptive folders and further information on the specification chemicals listed above. Additional copies of this chart are available on request.

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AMERICAN CHEMICAL PAINT COMPANY

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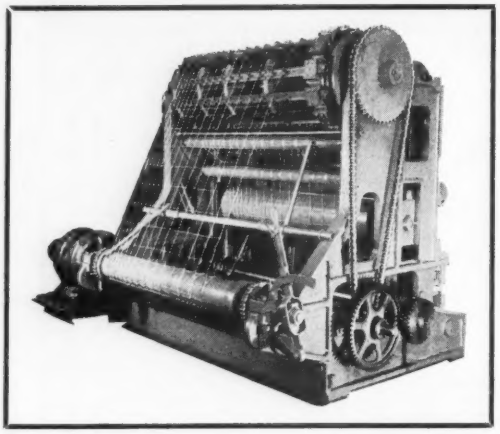
Manufacturers of Metallurgical, Agricultural and Pharmaceutical Chemicals

INTERLOCKING FENCE LOOMS



- Fastest --- Most Efficient.
- Preferred by Leading Mills.
- Low Maintenance Cost.
- Wrapped Stay Fence.
- Straight Stay Wires.
- Integrated --- Space Saving.
- Replaceable Main Bearings.
- Single or Double Strands.
- Years of Low Cost Production.

Write for Detailed Information — Without Obligation

Interlocking Fence Co., Dept. L, Morton, Ill.

Specialists In Fence Looms

MODERN-SAFE-EFFICIENT

ROD BAKERS - NAIL BLUERS
OVENS - FOR TEMPERING
ANNEALING
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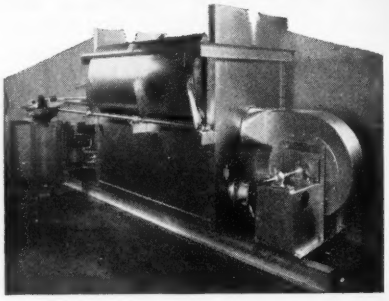
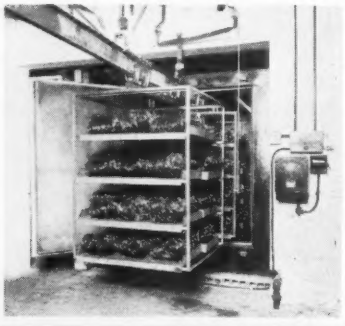
PAINT BAKING

FULL AUTOMATIC CONTROL — COMPLETE SYSTEM OF SAFETY DEVICES FOR BURNER EQUIPMENT.



Dry-Sys "Rapid" Rod Baker—Cover Doors Motor Operated—Rapid Circulation of Hot Air Thru Rods—Uniform Temperature — Automatic Control.

Dry-Sys Nail Bluing Oven — Gas Heated Rotating Drum—Uniformly Heated by Rapid Hot Air Circulation—Automatic Control.



Dry-Sys Spring Tempering and Annealing Oven — Gas Heated. External Heating Unit—Hot Air Circulating System—Automatic Temperature Control — Safety Devices.

STEAM - GAS - OIL - ELECTRIC
ALL TYPES OF OVENS
BATCH OR CONVEYOR TYPE
DESIGNED TO MEET THE
INDIVIDUAL NEEDS OF USER.

Phone or Write for Quotation
No Obligation.

DRYING SYSTEMS, INC.
ENGINEERS — MANUFACTURERS — CONTRACTORS
1810-B FOSTER AV., CHICAGO 40, ILL.

Outstanding Personalities of the Wire Industry

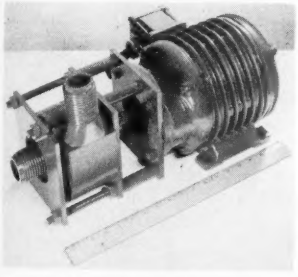
Gerard E. Claussen of Reid-Avery Company

GERARD E. CLAUSSEN one of the authors of "Steel Welding Wire," was educated in the public schools of Brooklyn, New York and received degrees from Polytechnic Institute of Brooklyn, Massachusetts Institute of Technology, and University of Sheffield. From 1931 to 1933 he was instructor at Polytechnic Institute of Brooklyn. From 1936 to 1940 he was Research Assistant with the Welding Research Committee. From 1940 to 1942 he was Metallurgist with Machlett Laboratories, Inc. and from 1942 to date has been Metallurgist with Reid-Avery Company, Inc. At present he is Chairman of the Maryland Section, American Welding Society, and Vice-Chairman of the Baltimore Chapter, American Society of Metals.

Harold E. Sincock of Reid-Avery Company

HAROLD E. SINCOCK co-author of "Steel Welding Wire," was educated in the public schools of Bethlehem, Pennsylvania, and Baltimore, Maryland. He received a degree of B.S. in Chemical Engineering from Lehigh University in 1931. From 1931 to 1933, he taught in the Baltimore County School System. From 1933 to 1942 he acquired his experience and training in steel making in the Metallurgical Department of the Bethlehem Steel Company. Since 1942, he has been Chief Chemist of the Reid-Avery Company. He is a member of the Sigma Xi Honorary Research Society.

PUMPS



NU-KAST PUMP #166

No stuffing box.

Available in 75 gpm at 16′ head and 95 gpm at 60′ head.

Complete with or without motor and/or pulley mount.

May be had with flanges for Van Stone connections.

Made of cast resins.

FOR PICKLING SOLUTIONS

No Metal in Contact with Solutions

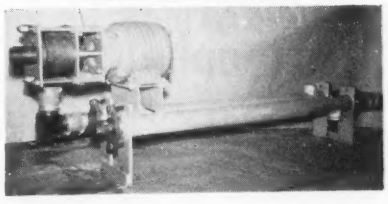
* COMPACT
* CORROSION RESISTANT
* EFFICIENT
* DEPENDABLE
* LOW PRICED

Resistant to Practically All Acids and Alkalies

IMMEDIATE DELIVERY

Write For Bulletin or Submit Specific Problem To

HEAT EXCHANGERS



NUKEM KARBATE EXCHANGER #29

Exchanger tubes are Karbate.

Excellent heat transfer with fast heat-up time.

Solution circulates at high velocity.

Capacities 400-1,400 gallons from 60-170° F. in 2½ hours with steam pressure 10 lbs., also 700-2,400 gallons with steam pressure 45 lbs.

Simple fittings and connections.

Short Straight runs.

NUKEM PRODUCTS CORPORATION

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ACID PROOF MATERIALS • DESIGN • CONSTRUCTION

The SPECIALISTS in Wire-Straightening and Wire-Cutting!

Diameter Range — 1/16" to .005"

PRECISION - Our Motto

DON'T hesitate to call on us when you are confronted with wire-straightening problems involving close tolerances and absolute accuracy. For seventeen years we have specialized in straightening and cutting all gauges of fine wire, hard or soft, ranging in diameter from one-sixteenth of an inch down to five-thousandths of an inch. We employ gun-barrel accuracy in straightening lengths from one inch to ten feet or any fractional part thereof. Ends cut absolutely clean without burrs.

●

ASK ABOUT OUR UNEXCELLED FACILITIES FOR CLEANING AND POINTING WIRE ALREADY STRAIGHTENED AND CUT.

ALL TYPES OF WIRE...

- Nickel
- Stainless Steel
- Bronze
- Brass
- Copper
- Alloy Wire
- Music Wire
- Tag Wire
- Florist Wire

Write us today!

Manufacturers of the famous ARMA PAPER CLIP

PITTSBURGH CUT WIRE COMPANY

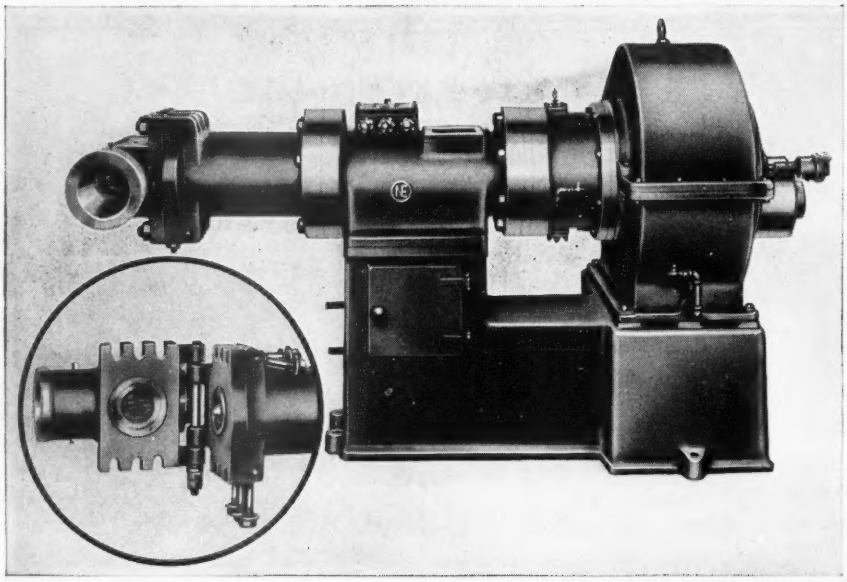
1112-20 GALVESTON AVENUE · PITTSBURGH, PENNSYLVANIA.

TELEPHONE: CEdar 4702

Plastics

INSULATION EXTRUDER

This sturdy 4-1/2" steam heated plastic insulation wire covering machine has large capacity to permit faster operation on a wide range of wire diameters. This same machine with minor changes can be converted for rubber insulation. These machines may also be arranged for either electric contact or oil heating of the cylinder. Consult with National-Erie engineers for recommendations.



National-Erie 4-1/2" Wire Extruder designed to handle "Geon" plastic insulation.

NATIONAL ERIE CORPORATION

ERIE, PENNSYLVANIA • U. S. A.

T. A. Cleary, Sr., Moved Up by Youngstown

THOMAS A. CLEARY, SR. has been appointed general superintendent of the Campbell Works steel plant and Struthers works of **The Youngstown Sheet and Tube Company.** He succeeds **William H. Yeckley** who recently was appointed an assistant to the vice president in charge of operations.

★ ★ ★

CLEARY is a native of Sharon, Pa., attended public schools there, and began working at the age of 15 as a weighmaster for Carnegie Steel Co., now a part of the Carnegie-Illinois Steel Corporation.

★ ★ ★

EARLY in 1915 Cleary joined Brier Hill Steel Company of Youngstown as a laborer in the open hearth department. This company was purchased by The Youngstown Sheet and Tube Company eight years later.

★ ★ ★

NIGHT school and correspondence courses in chemistry and metallurgy helped pave the way for Cleary's advancement to open hearth recorder, mixer foreman, stockhouse foreman, open hearth clerk, scrap inspector, third helper, second helper, first helper, melter, turn foreman, assistant superintendent of Brier Hill open hearth, superintendent of Brier Hill open hearth and then superintendent of Campbell Works open hearth and Bessemer.

★ ★ ★

HE is chairman of the northern Ohio section, and a member of the national executive committee of the American Institute of Mining and Metallurgical Engineers and is a member of the American Iron and Steel Institute. During World War I he served in the infantry and in the chemical warfare service. A son, Thomas A. Cleary, Jr., is employed by Youngstown.

★ ★ ★

Durant Opens Southern Branch

HAROLD V. BARKER has been made manager of the new Southern branch office recently opened by **Durant Manufacturing Company,** Milwaukee, Wisc., manufacturing counting and measuring machines.

★ ★ ★

MR. BAKER will be located in Greenville, South Carolina, on Route #7. A complete stock of Productimeters will be carried there, together with a repair and service department. Other Durant branches in the South are in Atlanta, Chattanooga, Birmingham and New Orleans.

★ ★ ★

Atlantic Steel Company Appointments

F. A. TEEPLE, Jr., was named manager of the newly formed product engineering department of the **Atlantic Steel Co.,** Atlanta, Ga. He previously served as superintendent of the company's manufactured products division. Mr. Teeple's supporting staff of metallurgical and product engineers is composed of **Fred O. Reese, Emmett R. Rushin, Lawrence A. Wallace** and **Michael F. Wiedl, Jr.**

★ ★ ★

Thermoplastic Cable Sheathing Kraft*

used in new constructions in

NONMETALLIC SHEATHED CABLE

instead of waxed paper

improves flame properties.

This paper is made by

Merrimac Paper Co., Inc.

Mills — Lawrence, Mass.

295 Madison Ave., New York City

Also Manufacturers of
Kraft Underground Cable Insulation
and other Specification Papers.

* Patent applied for.

Wendes Made Production Manager, Naugatuck Chemical Division

APPOINTMENT of **John C. H. Wendes** as production manager of the Naugatuck Chemical division, United States Rubber Company, was announced recently by John P. Coe, vice president and general manager.

★ ★ ★

MR. WENDES will supervise all manufacturing and engineering operations in the synthetic rubber plants operated by the division in Naugatuck, Conn., Port Neches, Texas, and Borger, Texas. He will also supervise manufacturing and engineering activities in the Marvinol vinyl resin plant at Painesville, Ohio, and the Naugatuck Chemical Plant at Naugatuck.

★ ★ ★

AT the same time, Mr. Coe announced the appointment of **Joseph P. Monahan** as general control manager of the Naugatuck Chemical division. Mr. Monahan will be in executive charge of accounting and accounting control in all four plants of the division.

★ ★ ★

FOR QUICK, ACCURATE MEASUREMENT OF WIRES OR CABLES . . .

Wires or cables passing through this machine are accurately measured and their lengths recorded on an easily read counter. Lengths up to 100,000 feet . . . nearly 19 miles . . . can be registered. Counter can be easily set back to zero at the start of a run. Machine is also available with counter mounted on right side. It can also be supplied with electric predetermined counter if desired.

Heavy cast iron standard, optionally supplied, provides firm support for machine, may be easily moved about on its rollers and adjusted to proper height by the rack and pinion. Machine illustrated is made in two sizes — No. 1 for measuring wires to 5/8" diameter and No. 2 for wires to 1½". We also manufacture a small bench type machine for measuring any flexible material not over 5/16" diameter.

For complete specifications ask for Circular No. 1

NEW ENGLAND BUTT COMPANY
Established 1842
304 PEARL STREET • PROVIDENCE 7, R. I., U. S. A.

JAMES DAY, MACHINERY LTD., 90 REGENT ST., LONDON, W-1, ENGLAND

BOTH men will make their headquarters in Naugatuck, Conn.

★ ★ ★

Crucible Steel Company of America Appointment

GEORGE M. BURRIER has been appointed assistant general superintendent of the Midland Works of **Crucible Steel Co. of America.** Mr. Burrier succeeds **M. J. Meinen,** who has resigned to take a position with another company.

★ ★ ★

Union Wire Rope Corp. Appointment

ARNOLD P. LITMAN has been appointed chief metallurgist of **Union Wire Rope Corp.,** Kansas City, Mo.

★ ★ ★

R. A. Sternthall Appointment

RAYMOND A. STERNTHALL was named to the post of branch manager of the Los Angeles office and warehouse of **Chase Brass & Copper Co.** Mr. Sternthall succeeds the late **T. Franklin Day,** who passed away recently. Mr. Day had been manager at Los Angeles for 16 years.

★ ★ ★

John M. Angier

JOHN M. ANGIER, 41, president of **Angier Corp.,** Framingham, Mass. industrial paper manufacturers, died on September 4, following a brief illness.

AFTER leaving Harvard College in 1929 Mr. Angier joined the firm established by his father in 1935.

★ ★ ★

Processing of Aluminum Alloys with Tungsten Carbide Drawing Dies

(*Continued from page* 886)

NAIL making, another form of cold heading, but using a split gripper die rather than a solid quill, is well under way in the aluminum industry. For example, in some cases, steel large head roofing nails are being produced more economically using carbide dies, but further improvements in the art are necessary before it may be classified as a universal application. However, manufacture of aluminum large head roofing nails

is an accepted and proven application on carbide nail dies.

★ ★ ★

GRIPPER dies on high speed headers will require some modification to eliminate the fine slivers that have a tendency to "build up" on the shear edges of the tool. Recent improvements in tool design have shown much promise toward the elimination of this problem.

★ ★ ★

WHILE rolling is the most important fabricating method for the production of shapes ordinarily classified as rod and bar, with hydraulic extrusion a close second for the production of intricate shapes, as well as simple geometric sections, an entirely different process is used for the final fabrication of wire. This is the cold drawing method, where the ⅜" rod is drawn through successive dies, each one progressively smaller in diameter by predetermined reductions until the desired diameter is reached. Reasons for using this method are its high productivity, its ability to produce the desired physical properties, speed of handling, the necessary close tolerances and finishes to which the product must be produced, as well as facilitating the scheduling of heat treating at intermediate points of the reducing process to produce the aforementioned fine physical requirements.

★ ★ ★

COMPOSITION and tensile strength of typical wire alloys are shown in the following table: (*See top of page.*)

TABLE II

Aluminum Alloy	Manganese	Magnesium	Chromium	Typical Tensile strength p.s.i. Annealed	Full hard
E.C. *				12,000	27,000 #
2 S †				13,000	24,000
3 S	1.2			16,000	29,000
52 S		2.5	.25	27,000	41,000
56 S	.1	5.2	.1	42,000	62,000

* E.C.—Electrical Conductor grade 99.45 Aluminum.
† 99 pct minimum Aluminum.
# Extra hard.

★ ★ ★

IN recent years, the starting coil weight has been increased from 120 lb. of ⅜" diameter redraw rod to 230 lb. as well as important improvements in rod quality.

★ ★ ★

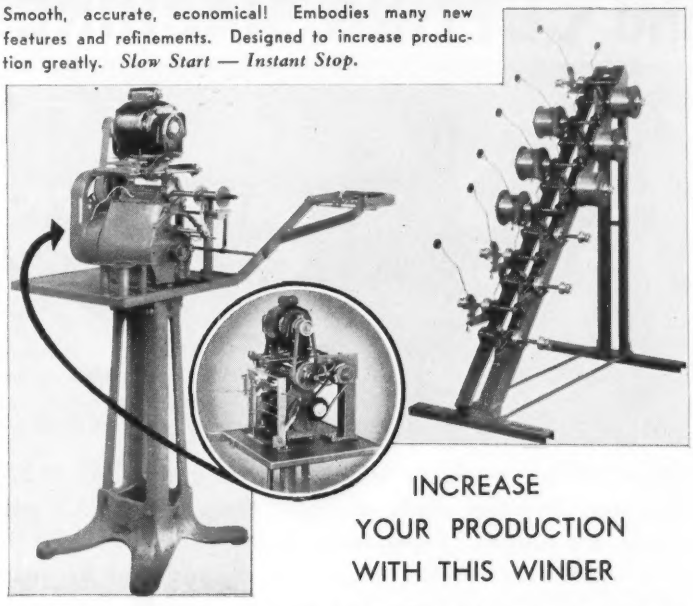
ALUMINUM rod does not require a coating or cleaning operation before drawing. The necessity for an anneal at the rod size is determined by the alloy and the desired reduction. The elimination of the coating or cleaning operation, of course, eliminates the cleaning house with its acid tanks, lime tubs, special coatings, bakers, etc.

★ ★ ★

WIRE drawing equipment does not depart from the conventional. The rolled rod may first run on block type machines or hooded 8 to 12 die, cone or tandem machines. Blocks may be of the single, double deck or multiple synchronized types. Drawing speeds vary from 400 FPM for the

STANDARD UNI-DRIVE WIRE WINDER.

Smooth, accurate, economical! Embodies many new features and refinements. Designed to increase production greatly. *Slow Start — Instant Stop.*



INCREASE YOUR PRODUCTION WITH THIS WINDER

Some outstanding features are: elimination of main drive belts; traverse adjustable to various distances between spool heads—from 1 5/8" to 5½"—without changing cam; winds up to 12 ends of wire on each spool; winds ends evenly in flat ribbon in perfect alignment with spool heads; each strand of wire lays parallel to the next with no under-winding, over-winding, tight or loose spaces; starts gradually; driven by ¼ H. P. A. C. 110 volt, 60 cycle, single phase motor.

PAYOFF

Our payoff attachment is made with self-aligning ball bearings and a compensating attachment to control the tension of each end. Applies same tension when spool is empty as when full.

STANDARD MILL SUPPLY
PAWTUCKET, R.I., 1064-1080 Main St.
NEW YORK, N.Y., 6708 Empire State Bldg.
CHARLOTTE, N. C., 2319 Hutchison Ave.

larger sizes to 4,000 to 5,000 FPM for fine wire. Lubricants for drawing include petroleum base oils and heavy greases. Petroleum base oils are considered superior from such standpoints as die scratching and wear. Neutral powdered soap is considered an excellent lubricant if staining of the finished product can be tolerated. Refrigeration of the recirculated lubricant is generally necessary to control and maintain properly low temperature.

* * *

TUNGSTEN carbide dies are generally used for wire .030" diameter and larger with diamond dies being used for the finer wire, with the exception of short run, special size requirements. Total reductions as high as 96% may be taken with most alloys, although some of the special, high strength materials may require annealing after 60-65%.

* * *

TYPICAL die design follows closely principles used in drawing other non-ferrous materials with approach angles from 16° to 24° included, depending on the wire diameter, and bearing length of 20% to 50% of the diameter.

* * *

ADEQUATE bell and sufficiently long entrance angle are a prime requisite. An industry standard R-6 die is generally used for the breakdown passes where the ⅜" rod is used on continuous drawing machines. The high ductility of aluminum and the resulting lower stresses induced in the die permit the use of smaller die cases than would normally be employed for drawing steel wire of equivalent size. Properly designed and maintained back relief is a very important adjunct of the die used for drawing aluminum wire.

* * *

EVEN though die life is much improved by the use of carbide dies, true economy may only be effected by a closely policed maintenance program. Very seldom is a die worn oversize on the bearing as a result of wear caused by friction. More often than not, the dies are "kicked" oversize in the polishing operation necessary to eliminate the wear ring in the approach angle. Experience with various alloys and operating conditions dictates the intervals that should be established for periodic die polishing and conditioning.

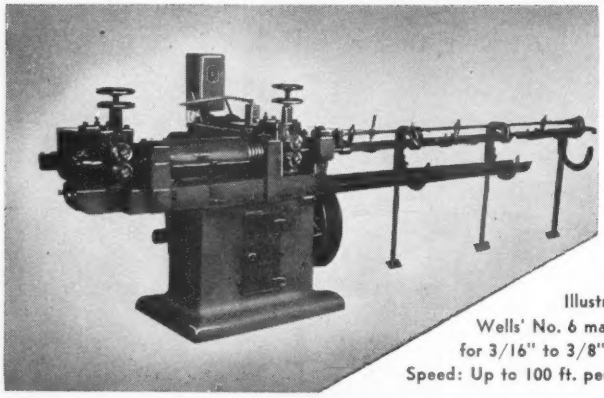
* * *

IT can readily be seen that the newly adopted industry standard carbide draw die design with its increased nib height and preformed back relief is very efficiently adapted to the manufacture of Aluminum wire, as well as ferrous and other non-ferrous materials. There is no doubt that carbide, with its superior wear resistant qualities and possible superior long lasting super finishing characteristics, will be instrumental in many future developments of Aluminum and Aluminum alloy products.

* * *

Bibliography credit should be given to Aluminum Company of America, T. W. Ennor, paper presented to A.I.M.E. Symposium series for 1949, Volume III, P. J. McCarthy, A. W. Lindsley; H. S. Spaulding, Wire and Wire Products, 1946; C. Beneke, Reynolds Alloys, Louisville, Ky.

Wells' STRAIGHTENING and CUTTING MACHINES



Illustrated:
Wells' No. 6 machine
for 3/16" to 3/8" wire.
Speed: Up to 100 ft. per min.

Other WELLS' machines will handle wire from 1/16" to 5/8 diameter: Precision made of finest steels, all WELLS' machines are rugged, dependable and low in cost, built to long, continuous service. They are the result of 57 years of cumulative experience and may be bought with confidence of satisfactory performance.

WELLS employs no salesmen or agents. All inquiries and orders handled courteously and efficiently by the Home Office at Kenosha, Wisconsin.

Send for Catalog No. 50 describing these and other WELLS' wire working machines. Please address inquiries to:

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5821 Fifth Avenue

KENOSHA • WISCONSIN

Builders of Wire Working Machinery

A Review of Recent Wire Patents

NO. 2,517,230, MULTISTRAND ELECTRICAL CONDUCTOR, patented August 1, 1950, by Edward B. Passow, Park Ridge, Ill., assignor to Zenich Radio Corporation, a corporation of Illinois.

An inductance coil is provided comprising a number of turns of a multistranded flat conductive tape which has a thickness small compared with its width and which is flexible in all directions transverse to its length; this tape including a number of flat conductive strips positioned in side by side relation in electrical contact along portions of their adjacent edges and a flexible strand interwoven with the conductive strips to form in conjunction therewith the flat tape.

★ ★ ★

NO. 2,517,244, UNIVERSAL ALL WIRE HOLDER, patented August 1, 1950, by Raymond R. Rundell, Miami, Fla.

This article holding clip-like bracket is constructed of a single length of wire.

★ ★ ★

NO. 2,517,309, WIRE STRAIGHTENER, patented August 1, 1950, by Richard D. Heller, Tujunga, Calif.

The straightener includes a bracket and a lever mounted on the bracket and both disposed lengthwise of the wire to be straightened. The lever is pivoted intermediate its ends and carries a wire-engaging roller at each end which engage opposite sides of the wire. There are also two rollers mounted to rotate upon the bracket and cooperate with the first rollers.

★ ★ ★

NO. 2,517,343, STRAIGHTENING MACHINE, patented August 1, 1950. by John Burley Picton and Ernest Lambert Tinley, Wolverhampton, England, assignors to Joshua Bigwood & Son, Limited, Wolverhampton, England.

Rolled metal sections are straightened by this machine, which includes a correcting roll. There are 10 claims.

★ ★ ★

NO. 2,517,344, MACHINE FOR STRAIGHTENING RODS OR TUBES, patented August 1, 1950, by John Burley Picton and Ernest Lambert Tinley, Wolverhampton, England, assignors to Joshua Bigwood & Son, Limited, Wolverhampton, England, a British Company.

This patent, related to the above, includes the feed mechanism of the machine.

★ ★ ★

NO. 2,517,381, MACHINE FOR MAKING INSULATED CONDUCTORS, patented August 1, 1950, by Stanley E. Boynton, Westfield, and Waldemar C. Ewaldson, Millington, N. J., assignors to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York.

More specifically the invention covers a mounting for a hollow spindle, through which a core with an attached ribbon of pulpous material may be advanced, open laterally for a portion of its length and having devices adjacent the open portion to form the material about the core while the spindle is rotated by a drive member when engaged by a driven member mounted on the spindle.

★ ★ ★

NO. 2,517,476, CAP SCREW, patented August 1, 1950, by Frank E. Frost, Chicago, Ill., assignor of one-half to Kenneth T. Snow, Oak Park, Ill.

In the lower part of the head of the screw is a slot defining a thin lower lip whereby when the cap screw is drawn up against a relatively flat surface the thin lower lip springs upwardly against the head causing an automatic spring locking of the cap screw.

★ ★ ★

NO. 2,517,493, WIRE STAMPING MACHINE, patented August 1, 1950, by Lewis A. Kingsley, Los Angeles, Calif.

The length of wire advanced for stamping is variable due to a lever having a movable fulcrum and arm movable

Complete Description and Drawings of Patents May Be Had for 50 cents, outside the United States and Canada $1.00. Address, Wire & Wire Products, 300 Main St., Stamford, Conn.

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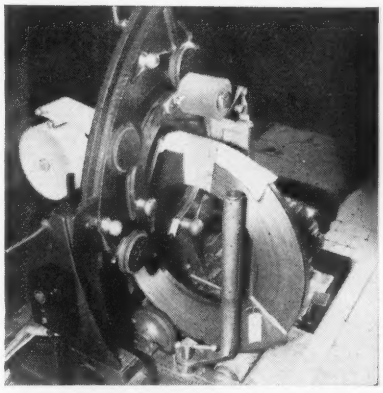

(Photo courtesy Wallace Barnes Co., Bristol, Conn.)

Not 1500 pounds wrapped—but 3500 an hour! That is part of the savings discovered by Wallace Barnes Co., Division of Associated Spring Corp., Bristol, Conn., when Angier VPI Wrap was adopted to simplify rust prevention of carbon steel coils. "On many shipments using VPI," says purchasing department's R. O. Johnson, "we have been able to avoid customary coil wrapping and thereby pass packaging savings on to our customers."

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( ) Instruments and clocks.
( ) Ordnance Equipment.
( ) Others:

(USE MARGIN for name, title, firm, address.)

in proportion to the movement of the wire.

★ ★ ★

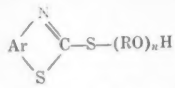
NO. 2,517,722, WIRE WINDING APPARATUS, patented August 8, 1950, by Paul A. Schmidt, near Earlville, Ill.

This apparatus is adapted to be wheeled over the ground for winding the wire.

★ ★ ★

NO. 2,518,109, PICKLING OF METALS, patented August 8, 1950, by Richard O. Zerbe, Nitro, W. Va., assignor to Monsanto Chemical Company, St. Louis, Mo., a corporation of Delaware.

The process comprises subjecting the metal to be pickled to the action of a heated nonoxidizing mineral acid solution containing about 0.2 to 0.5 percent by weight based upon 100 percent acid of a compound of the structure where



Ar is an artho arylene radical, R is an alkylene radical and n is an integer greater than one but less than thirty-one.

★ ★ ★

NO. 2,518,438, PROTECTIVE COATINGS, patented August 15, 1950, by Helen Sellei Beretvas, Chicago, Ill., assignor to Nox-Rust Corporation, a corporation of Illinois.

There is provided a protective coating for surfaces consisting essentially of at least 2 percent of a metal naphthenate soap formed from naphthenic acid and a metal of the group of copper, magnesium, calcium, zinc, strontium, barium, tin, lead, chromium, manganese, iron cobalt and nickel, a metal tall oil soap formed from tall oil acid and a metal of the group of copper, magnesium, calcium, zinc, strontium, barium, tin, lead, chromium, manganese, iron, cobalt and nickel and a carrying vehicle which acts as a solvent for said soaps.

★ ★ ★

NO. 2,518,534, STRAND MATERIAL STORAGE DEVICE, patented August 15, 1950, by Edward W. Ertner, Berwyn, Ill., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York.

A unitary device for storing a multiple looped constant length of a wire traveling to a capstan of the machine from a wire supply source located below the capstan is provided by this patent.

★ ★ ★

NO. 2,519,367, METHOD OF AND APPARATUS FOR DETECTING DEFECTS IN OBJECTS, patented August 22, 1950, by Ross Gunn and Jacob E. Dinger, Washington, D. C.

More specifically, the apparatus is for testing axially symmetrical objects of electrically conducting material.

★ ★ ★

NO. 2,519,398, WIRE CLOTHESPIN, patented August 22, 1950, by Charles S. Read, New Smyra Beach, Fla., assignor of one-third to Carl Anker, Edgewater, Fla.

The clothespin comprises a length of wire, bent to shape.

★ ★ ★

NO. 2,519,461, STRAND DISTRIBUTING APPARATUS, patented August 22, 1950, by Estyle D. Hanson, Baltimore, Md., assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York.

The apparatus is for use with a strand takeup mechanism which has a double threaded traversing screw and nut uniformly reciprocated thereby.

★ ★ ★

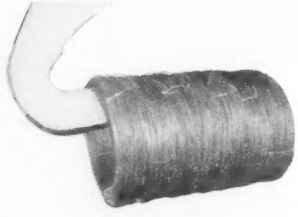
NO. 2,520,356, METHOD FOR INHIBITING CORROSION OF FERROUS METAL, patented August 29, 1950, by John W. Bishop, Cranford, N. J., assignor to Tide Water Associated Oil Company, Bayonne, N. J., a corporation of Delaware.

The surface of the iron material is coated with a non-corrosive liquid having dissolved therein a small amount, sufficient to increase the rust-preventive characteristics of this liquid, of a teritary alkyl alkylolamine containing an alkylol group esterified with a long chain fatty acid obtained by hydrolysis of a member of the group consisting of naturally-occurring fats and naturally-occurring fatty oils.

★ ★ ★

NO. 2,520,818, RECEPTACLE SUPPORT, patented August 29, 1950,

Are you using Steam for your wire baking?



STEAM can be an excellent heat source for most processing operations, BUT NOT FOR WIRE BAKING. Experience throughout the wire industry has proven that its temperature limitation, rusting effect on coils, leakage from coils and similar disadvantages result in sizable losses in time, labor and materials.

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ROSS ENGINEERING OF CANADA, LIMITED, MONTREAL, CANADA • CARRIER-ROSS ENGINEERING COMPANY, LIMITED, LONDON, ENGLAND

by Charles W. Terry, Tulsa, Okla.

This is a drinking glass holder, adapted to be used on lawns, and is formed from a single length of wire.

★ ★ ★

NO. 2,519,127, METHOD OF DRAWING STAINLESS STEEL WIRE, patented August 15, 1950, by Carl H. Fessler, Cleveland, Ohio, assignor to The American Steel and Wire Company of New Jersey, a corporation of New Jersey.

The improvement comprises annealing the stock in an atmosphere of combustion gases containing about 2% carbon monoxide so as to form a scale thereon, contacting the scale on this annealed stock with a strongly alkaline water solution at elevated temperature for a time less than that required to remove substantial amounts of the scale from the stock, lubricating the scaled stock and die-working the scaled and lubricated stock while cold.

★ ★ ★

Informative New Manual on Technical Cements Now Available

CONSIDERED a practical handbook on the application of adhesive cements and compounds, and worthy of careful reading is the exhaustive new Engineers' Production Manual just issued by **Sauereisen Cements Co.**, Sharpsburg Station, Pittsburgh 15, Pa.

★ ★ ★

IT contains 64 pages of useful information, with over 150 illustrations, data and charts, and will prove of value to laboratory technicians, production men, engineers and everyone interested in the application of technical cements. A free copy of this 64-page book will be sent on request.

★ ★ ★

Precision Thermostat for High Temperatures

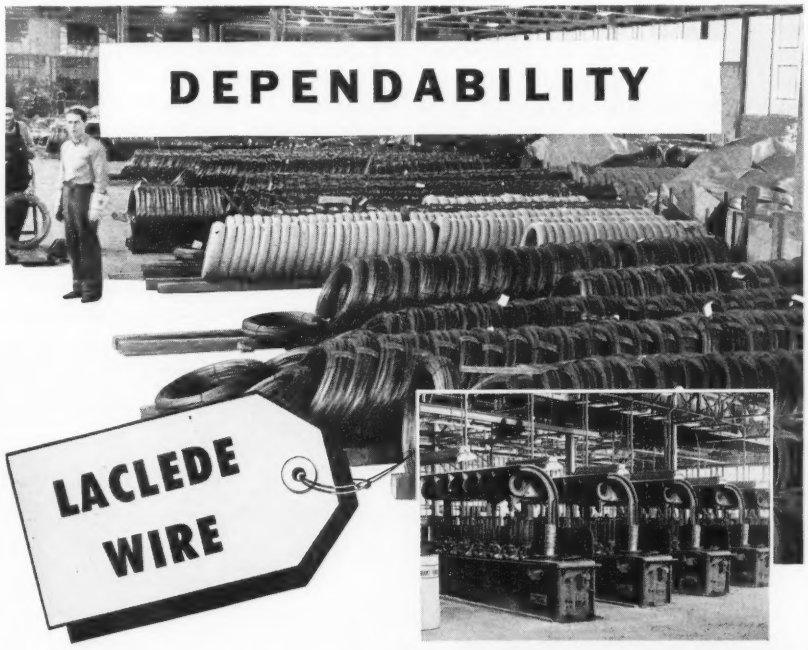
AN improved precision thermostat developed by Dr. Wm. R. Eubank at the National Bureau of Standards provides smooth, continuous control of an electric furnace within a very small range at temperatures between 1000° and 1550°C. The device is of the type in which the furnace winding itself serves as the sensitive element, forming part of a bridge circuit for control of a thyratron tube. The thyratron circuit then acts as a continuously variable valve, allowing just enough current to reach the furnace to compensate for a given temperature fluctuation. The new thermostat is highly sensitive and independent of normal fluctuations in line voltage. As it is convenient to operate, easily adjusted for any temperature, and reliable for periods of continuous operation from a few minutes to several days, it should provide a useful research tool in such fields as metallurgy, ceramics, glass technology, and cement chemistry, where automatic control of furnace temperatures has long been a problem.

★ ★ ★

Booklet on Polyethylene

THE BAKELITE DIVISION, UNION CARBIDE and CARBON CORPORATION, 300 Madison Avenue, New York 17, N. Y., has issued a 24-page booklet entitled, "Bakelite Polyethylene" describing the various characteristics and uses of this plastic compound, which among other things has found wide use in the sheathing of electric wire and cable. Copies will be sent to interested readers upon receipt of requests.

★ ★ ★



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St. Louis, Mo.

Steel Welding Wire

(*Continued from page 847*)

taining 20% to 26% manganese, the resulting weld metal containing .06% to .18% carbon, .60 to .90% manganese, .030% phosphorus max., .030% sulfur max., and .20 to .40% silicon. The weld metal deposited by the 2% manganese wire has approximately the same analysis as the deposit from the plain carbon wire. A flux containing no manganese or 5% manganese is used with the 2% manganese wire. If the plain carbon wire is used with the flux containing no manganese, the deposit may contain as low as .40% manganese and the yield strength may fall below 50,000 PSI. If, on the other hand, the 2% manganese wire is used with the flux containing 26% manganese, the manganese will rise to 1.5% or more in the deposit.

★ ★ ★

A LARGER proportion, 40 to 50%, of base metal is fused into the average submerged arc weld than into a weld of the same size prepared with extruded electrodes. Consequently, the analysis of submerged arc weld metal depends on the steel being welded as well as on the current and the granulation of the flux. It is impossible, therefore, to state the average analysis of the weld metal deposited by submerged arc welding wire and flux except within wide limits. The low silicon content of the 2% manganese wire seems to be specified because high-silicon weld metal tends to crack in restrained joints.

★ ★ ★

Wire for Gas Welding

THREE steels commonly used as gas welding wire are listed in Table One. The dead soft wire is restricted in application to sheet metal and repair work where high strength is unimportant, but free flowing is essential. The killed plain-carbon steel will meet the requirements of Classification No. GA50 of American Welding Society Specification A5.2-46T for Iron and Steel Gas Welding Rods. The silicon content of this wire seems to confer the non-spitting, free - flowing characteristics desired by the torch operator.

★ ★ ★

FOR welds of high tensile strength low-alloy steel wire is used. The 1% manganese type in Table One not only is of Classification No. GA60 of the American Welding Society Specification, but is listed as Class One, Type B in Navy Department Specification 46R4b. There are many other equivalent compositions of low-alloy steel wire on the market for welding high-tensile piping, tubing, and plates. Despite their slightly higher cost, the alloy steel wires with their excellent useability are gaining in popularity over the plain carbon grades.

★ ★ ★

THE composition of gas weld metal depends not only on the

DIE GARD 80, DIE GARD 84, DIE GARD 89, DIE GARD 34, DIE GARD 36, DIE GARD 43, DIE GARD 80, DIE GARD 84, DIE GARD 89, DIE GARD 34, DIE GARD 36, DIE GARD 43, DIE GARD 80, DIE GARD 84, DIE GARD 89, DIE GARD 34, DIE GARD 36, DIE GARD 43, DIE GARD 80, DIE GARD 84, DIE GARD 89, DIE GARD 34, DIE GARD 36, DIE GARD 43, DIE GARD 80, DIE GARD 84, DIE GARD 89, DIE GARD 34, DIE GARD 36, DIE GARD 43, DIE GARD 80, DIE GARD 84, DIE GARD 89, DIE GARD 34, DIE GARD 36, DIE GARD 43, DIE GARD 80, DIE GARD 84, DIE GARD 89, DIE GARD 34, DIE GARD 36, DIE GARD 43, DIE GARD 80, DIE GARD 84, DIE GARD 89, DIE GARD 34, DIE GARD 36, DIE GARD 43, DIE GARD 80, DIE GARD 84, DIE GARD 89, DIE GARD 34, DIE GARD 36, DIE GARD 43,

Die Gard 34

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wire and the material to be welded, but also on the torch setting. An oxidizing flame will remove much of the carbon manganese, and silicon from the weld, while a reducing flame may add carbon to the weld. These factors must be borne in mind in interpreting the results in Table Eight.

★ ★ ★

PLAIN carbon gas welding wire as well as wire for submerged arc welding often is copper coated for appearance. The copper is extremely thin and amounts to less than 0.01% of the weight of the wire. The copper does not affect the welding behavior.

★ ★ ★

Summary

DESPITE the wide variety of welding processes and welding operations requiring filler metal, only a relatively few types of steel welding wire are produced in large quantities. For heavy covered and light coated electrodes low-carbon rimmed steel fills most requirements. Since the consumer properly demands a uniform product, the welding wire manufacturer also requires steel of uniform composition heat to heat and within a heat. Besides uniformity of composition and steelmaking procedure, the welding wire manufacturer is concerned also about surface cleanliness in order that coatings will adhere tightly.

★ ★ ★

THE tests reported in this paper show that the composition of the deposited weld metal and the usability characteristics of electrodes vary with the composition of the wire. Some coatings are more sensitive than others with respect to cleanliness and composition. The 6020 coating was particularly sensitive to changes in wire composition in these tests.

★ ★ ★

TABLE EIGHT

Composition of Weld Metal Pads Deposited by Three Gas Welding Wires 3/16 Inch Diameter.

	Wire Analysis					Analysis of Weld Pad*				
	C	Mn	P	S	Si	C	Mn	P	S	Si
Dead Soft	.05	.12	.020	.033	NIL	.02	.08	.022	.033	NIL
Killed Plain Carbon	.06	.41	.018	.028	.16	.06	.32	.018	.030	.06
Class GA 60	.17	1.14	.012	.026	.22	.15	.66	.012	.028	.14

* The weld pads were one inch high, two inches square prepared by qualified gas welder using a neutral flame.

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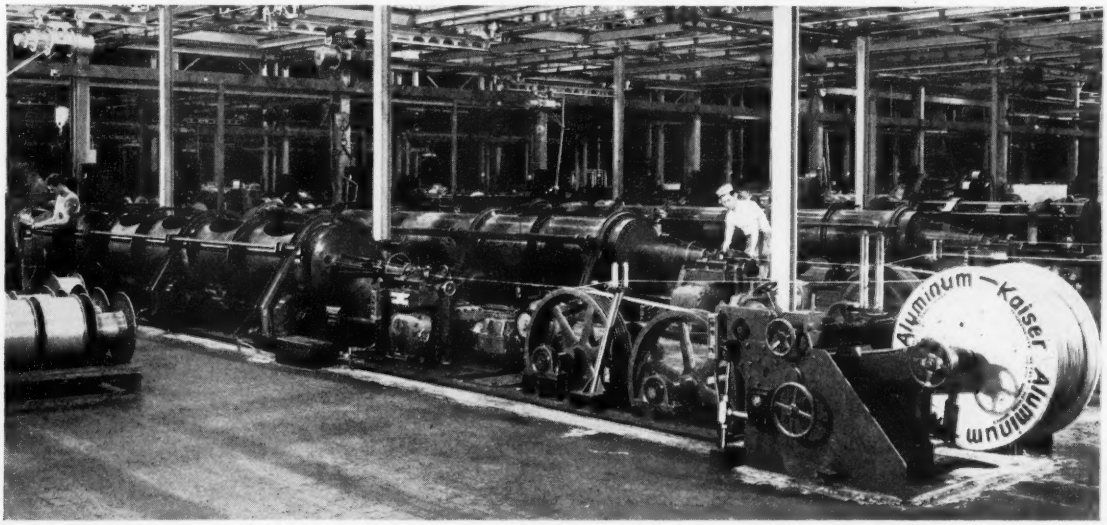
DOUBLE DRUM HAUL-OFF WITH LINK BELT P.I.V.—AIR OPERATED BRAKING SYSTEM



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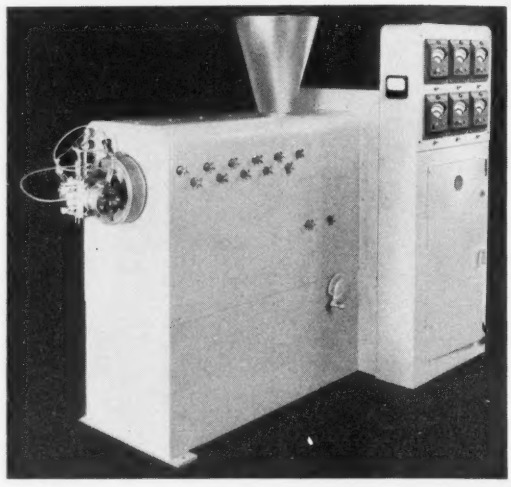

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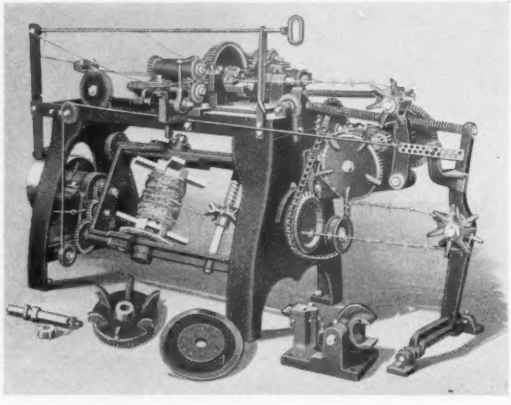
GLADER BARBED WIRE MACHINES



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GLADER COMBINATION BARB WIRE MACHINE . . . makes 2-point and 4-point barb wire.

GLADER BARB WIRE MACHINES also make 2-strand plain cable wire, without barbs.

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THE effect of wire composition on usability characteristics can be predicted for light coated electrodes rather closely from the welding behavior of the bare wire. For heavy covered electrodes on the contrary, the indications of the bare wire are less useful. The characteristics of the wire are masked by the heavy covering.

See photographs and biographies of authors under "Personalities."

The Role of Mill Service Men to Fabricators of Wire Products

(*Continued from page 850*)

tomers are usually assigned to the producers' metallurgical department, they have all the opportunity that time permits to increase their knowledge of the subjects just mentioned. Equally as important as the scholastic training of these men is the amount of knowledge they gain by studying the wire making equipment and by consulting with production personnel of their own wire mill. This knowledge gained in the production departments is valuable because it enables the men, in making calls on fabricators, to give opinions as to whether or not some of the things requested by these customers, such as unusual finishes, coil, spool or bar weights, coatings, close tolerances, etc., are feasible to the producing mills. Also, if complaints on material already received by the customer are being discussed, it will enable the callers to judge whether or not the wire producers' equipment had any bearing on the complaints.

★ ★ ★

THE training and experiences that acquaint these men with the manufacturing problems of the fabricators can only be gained by actual contact with such work. The more calls on various fabricators they have been able to make as representatives of the wire producers, the broader will be their knowledge of the fabricators' problems. It is also noted that if these men have been adept at increasing their fundamental scholastic learnings and at gaining knowledge by studying the wire making equipment and by consulting with production personnel, they will also be adept at learning the answers to the many and varied questions and problems that they will face in accompanying the wire producers' salesmen on calls to the various fabricators.

★ ★ ★

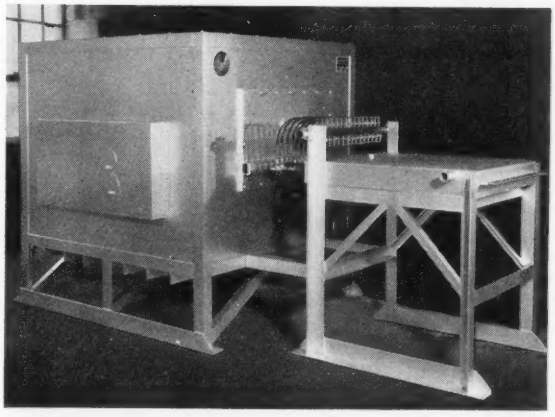
NOW that we have assumed the desirability of wire producers sending men direct from the wire mills to visit the customers and we have considered the education and training of these men, we should devote a few words to the manner of performance of their work.

★ ★ ★

THROUGH various statements made during the last few minutes, it is evident that these contact men, when working, will be

298,636 MILES OF WIRE ANNEALED IN ONE YEAR IN HARPER STRAND ANNEALER

operating 24 hours a day for two years, *with never a trace of trouble.*



This remarkably efficient 30-tube electric atmosphere furnace has been on the job continuously day and night at one plant annealing 304 stainless weaving wire in sizes of .020" to .0014". Temperatures of 2000° to 2200° F were used and speeds of 100 f.p.m. maintained. Softer wires run at somewhat lower speeds.

This HARPER furnace has practically eliminated rejections.

The annealing of stainless steel wire is a delicate job, requiring maintenance of temperatures within narrow limits. This HARPER unit has been of inestimable value in producing wire at exceptionally uniform quality. What HARPER has done for one mill can be duplicated for you on stainless or other metals.

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found at one of several places, namely, in the plants of the fabricators, in the production departments and laboratories of the wire producing mill, or at their desks making written reports concerning their activities and taking care of correspondence regarding various problems with which they are familiar.

★ ★ ★

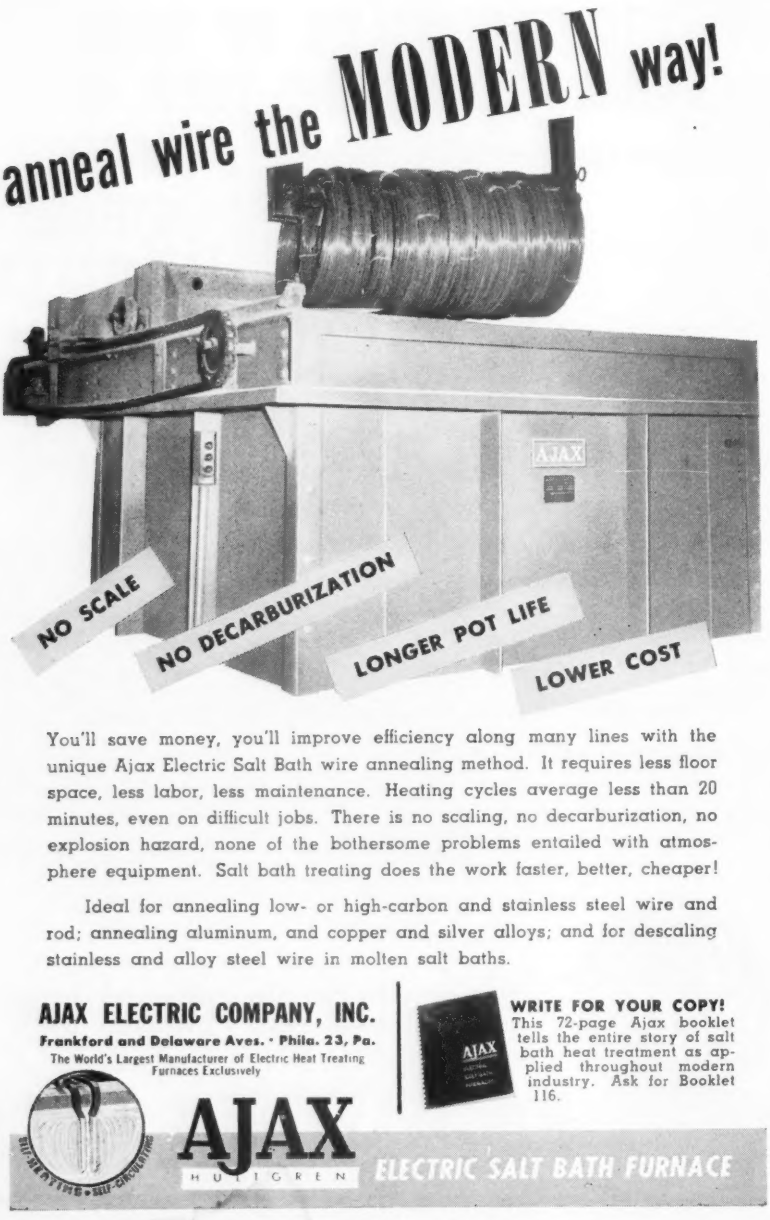
WHEN they are at fabricators' plants, it will, no doubt, be by prior arrangements between the personnel of the fabricators' purchasing departments and the wire makers sales departments. The subjects for discussion may be one or all of these several; namely, (1) new products for which the wire producers may have the right wire, (2) products at present being made by fabricator from wire supplied by mills represented by contact men present at particular discussion but the fabricators want a change in quality of the wire supplied, (3) products being made at present from wires supplied by producers other than the one represented at particular discussion but this producer would like opportunity to furnish the wires, (4) complaints on material furnished by mills represented by contact men present at particular discussion. If the first of the above is involved in discussion, the men direct from the producing wire mill will have to make a thorough survey of all properties desired by fabricator and determine whether or not they can economically produce a wire which will meet the requirements. In many cases it will be necessary for these men to request that other men from their organization who specialize in some of the requirements be called in to consult on the propositions. If it appears that wire can be made that will be satisfactory, test lots should be made to prove the assumptions. If the second of the four subjects of discussion is being considered, a study of the additional requirements as to quality of the wire presently being furnished may show that it will be necessary, before making a decision, for the mill contact men to consult further with others in his organization after his return to producing wire mill.

★ ★ ★

WHEN faced with the problems presented in number three of the above listed subjects most likely discussed in calls at fabricators' plants, the men from the wire makers' mills should be able to give an immediate answer as to whether or not their mill can produce wire of a quality that would induce the fabricator to change his source of supply.

★ ★ ★

WHEN the fourth subject of discussion, complaints, is involved, examination of the product and the wire it is made from is first to consider. After determining whether the faults lie in the fabricating equipment or in wire, there are a couple of possible contributing factors that the men from the wire mills can clarify. One is that in case the fabricators



You'll save money, you'll improve efficiency along many lines with the unique Ajax Electric Salt Bath wire annealing method. It requires less floor space, less labor, less maintenance. Heating cycles average less than 20 minutes, even on difficult jobs. There is no scaling, no decarburization, no explosion hazard, none of the bothersome problems entailed with atmosphere equipment. Salt bath treating does the work faster, better, cheaper!

Ideal for annealing low- or high-carbon and stainless steel wire and rod; annealing aluminum, and copper and silver alloys; and for descaling stainless and alloy steel wire in molten salt baths.

AJAX ELECTRIC COMPANY, INC.
Frankford and Delaware Aves. • Phila. 23, Pa.
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WRITE FOR YOUR COPY!
This 72-page Ajax booklet tells the entire story of salt bath heat treatment as applied throughout modern industry. Ask for Booklet 116.

AJAX HULTGREN ELECTRIC SALT BATH FURNACE

improperly ordered material, it should be determined whether or not the salesmen from the wire makers had an opportunity to know definitely whether or not correct wire had been ordered. If error was in producers' mill, these contact men should be able to immediately determine whether or not they or the wire salesmen had made sure needed available information was sent to producing wire mills. The discussions regarding many complaints cannot be completed during visits of these men from the producing wire mills as they will involve determination of chemical analysis, microstructure, etc.

★ ★ ★

BY now it should be perceived that, when back home at their wire mill, these contact men will be found in the production and laboratory departments discussing with the personnel the problems they have encountered during visits to various fabricators. Inasmuch as others in the organization outside of the production and laboratory personnel will probably be interested in their work, these men will also be found at their desks writing up permanent records of discussion both at fabricators' plants and in their own producing mills.

★ ★ ★

THE fact that these men from the producing wire mills who call on the fabricator-customers are seen and heard quite a little by the customers makes it important that they carry on their work well, and such work well done will be a credit to the wire producing organization they represent.

★ ★ ★

New Thread Roller Increases Production

THE doubling of thread rolling production not over a period of years, but in the development of a single machine, is no mean accomplishment.

★ ★ ★

THE D. H. PRUTTON MACHINERY and TOOL COMPANY, 5295 W. 130th St., Cleveland, Ohio, have made this contribution to the bolt, screw and nail industries. For years the planetary principle has been considered the way to achieve high production, if the principle could be applied in a practical way. It differs from the conventional reciprocating rolling method only in that the planetary roller uses a rotary rather than a reciprocating motion.

★ ★ ★

THE new "Rollmaster" No. 120 machine, built by Prutton threads eight bolts per cycle, against one of the older type. Increased production is gained by greater efficiency rather than in increased die speeds. 25,000 units per hour are said to be possible with this new machine in handling sizes up to ¼" diameter with thread lengths up to 3" long. Up to ½" stock can be rolled at the rate of 9000 per hour. The company also manufactures nut tapping machinery.

★ ★ ★

WIRE SPOOLS, ALL-STEEL, LITHOGRAPHED

Ends and traverses may be shipped separately and assembled easily in your plant on a hand, foot, or power press.

5" and 6½" diameter ends with 1-15/16" diameter traverses.
10½" diameter ends with 3½" diameter traverses.
Traverse lengths up to 12".

J. L. CLARK MANUFACTURING CO.
600 23rd AVENUE • ROCKFORD, ILLINOIS

The Oil-Filled Gas-Compression Cable

(*Continued from page 867*)

size of 5000 psi; moreover, the pipe is buried underground and is protected. The terminal portion above ground can easily be injured by a hammer, a bullet or a blow torch, and if this were to occur, the pressure medium in the line would be free to escape. One way to overcome this is put a stop-joint and manhole at each end of the pipe line, say within 50 or 100 feet of the terminals. This is undesirable for two reasons: First, stop-joints to date employ a squeeze-type joint or stuffing box; and second, it means an additional cost in our largest cities of $20,000. Fortunately, there is a much simpler solution.

★ ★ ★

BY making the spreaderhead of non-magnetic stainless steel of ¼ inch wall thickness so as to match the bursting strength of the pipe, and then by placing a non-squeeze type isolating or stop-gland in each riser tube as it leaves the spreader, the pressure medium is now completely and safely contained in a high strength steel cylinder. No stop-joints are necessary. The cable is pulled into the steel pipe at the terminal end for distances up to 3,000 feet or more, depending on the number of bends in the run. The spreaderhead is then threaded on and mounted in place either by a victaulic coupling or by welding. At an earlier stage of the work it is a wise precaution to slip a joint sleeve over the pipe with 2 reducers all adequately protected, so that in the remote case that an emergency arose and it was necessary to replace a short length of cable, the pipe could be cut, a splice could be made to a new piece of cable in the one phase only and the sleeve slipped in and welded in place. In nearly 50 of these installations abroad splicing in a new cable end has never been necessary.

★ ★ ★

THE spreaderhead stops must be by-passed to permit the pressure medium to either fill the riser tubes and terminals, or at least to communicate the pressure to the fluid in them. For the first condition a special valve is inserted in the by-pass piping which will keep the pressure medium in the ends under sufficient pressure if the pressure in the steel pipe line is lost; or in case the riser tubes are broken, will hold the pressure in the pipe line.

★ ★ ★

The CMH Accumulator

IN the second case, where it is desired to communicate the pressure in the pipe line to the medium in the terminal ends without allowing the pipe fluid to mix with the riser tube fluid, a CMH accumulator of 5 gallons displacement is inserted in the by-pass piping. This employs a flexible stainless steel membrane for transferring the pressure. It is very strong; in the input direction it requires approximately 8000 psi to burst it. The pressure drop across it is very small. It is provided with an indicator so that the position of the membrane can be inspected. A device is provided for maintaining 100 psi pressure on the terminal fluid even though pressure in the steel pipe line is lost.

★ ★ ★

NOW! LIQUID DRAWING COMPOUNDS

Longer die life... Finer finish!

with these new Shell drawing compounds

1. SHELLDRAW L7087 for fine wire

Shelldraw L7087 is a clear fluid that mixes readily with water *at room temperature*. Used in recommended emulsions, Shelldraw L7087 contributes new standards of wire finish and long die life . . . at the same time providing a "purging" action which keeps sumps and machines clean. This compound *will not foam in service.*

Shelldraw L7087 is suitable both for ferrous and non-ferrous wire in fine finished sizes. Economical, too, since the average emulsion contains only 2% of the compound.

2. SHELLDRAW L7073 for stainless steel

As a result of intensive investigation, Shelldraw L7073 is turning in a field record of remarkable results in the drawing of stainless steel wire, rod, tubes and press shapes . . . as well as products of beryllium-copper, nickel, monel, and other alloys! This premium product assures fine finish, extended die life and a minimum of galling and pickup.

Both of these cost-cutting Shell products are now available for general distribution. Mail the coupon for further information.

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50 West 50th Street, New York 20, N. Y.

Please send us data on Shelldraw L7087 ☐ Shelldraw L7073 ☐

Name_____

Company_____

Address_____

WHEN gas is used in the pipe line, the riser tubes and terminals may be filled with oil, and the CMH accumulator then serves to separate oil and gas completely. With the riser tubes and terminals filled with oil, no leakage of gas will be experienced, as oil of course does not pass through porous metal as does gas; and the nitrogen medium will be confined between spreaderheads in the steel pipeline. The latter in cable lines in this country has a perfect record as regards leakage. With this arrangement a device is included in the base of each terminal to keep it full of oil in case a riser tube is broken. The CMH accumulator is placed on the ground near the spreaderhead and the piping is then very short.

★ ★ ★

THE CMH accumulator is also very desirable in systems where oil is used in the pipe line instead of gas. The oil in the terminal end is under electric stress; it flows out of the cable and into the pipe on heating of the cable; and it flows back from the pipe into the cable on cooling of the cable. On the other hand, the bulk oil in the pipe may get dirty from rust or from lumps of asphalt in the pipe or by leakage at any one of the 200 fittings at the oil pumping station; certainly it absorbs nitrogen gas from the reservoir, and since the oil is degassed, i. e., has a negative pressuse of 15 psi, and the nitrogen above the oil is at 10 psi gauge, the oil in the system will sooner or later contain 25 psi (absolute) nitrogen. Now it is highly desirable to keep this bulk oil in the pipe from the electrical oil in the terminals, because if dirty oil runs in and out of the cable end, the paper insulation (dried and degassed) will absorb the impurities just as paper in a filter press cleans up oil. It can be proved that this does happen in cable pipes because Kidder[1] shows that the oil in the cable pipes improves in power factor with the years and because others have shown that radical power factor curves indicate that the outer layers of the cable insulation have a higher power factor due to absorption of impurities.[14] The effect is perhaps worse on 69 kv. cable than on 138 kv. because there are fewer layers of paper. By separating the oil under electric stress in the terminals from the bulk oil in the pipe by means of a CMH accumulator, terminal trouble of this type is eliminated.

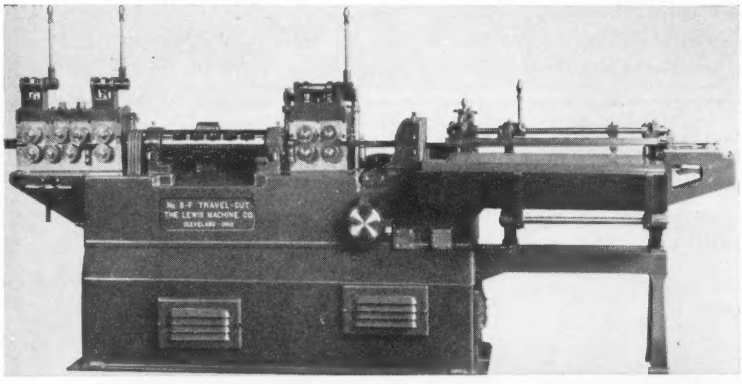
★ ★ ★

Anchoring the Pipe to the Terminal Structure

IT is possible to have a slight movement of the pipe relative to the terminal structure due to thermal expansion, although it has not been discernible where the pipe is brought up out of the ground in a right angle bend; or a larger movement due to earthquakes or earth movement, as in drying out of heavy clay soils. There are two schools of thought regarding the solution. One is to let the pipe float free, and provide flexibility by offsetting the spreader 6 feet or more from the terminal structure. The other is to anchor the pipe rigidly by means of a welded steel flange and a concrete block. Although the writer has favored the "free floating" method,

CUT YOUR CUTTING COST WITH

LEWIS TRAVEL-CUT



Wire Straightening & Cutting Machines

The simplicity of design and rigid construction of the Lewis Travel-Cut makes it well suited for the most severe high-production requirements. This machine feeds the wire from the coil, straightens, gauges to accurate length, and cuts while in motion thus producing uniform diameter rod free of arbor swell and feed roll marks. It is particularly adapted to precision work on bright finished steel, brass, aluminum, stainless, and alloy wire. This method of cutting is also very efficient for short lengths such as welding rod, special bolts, etc., and increases the over-all efficiency approximately 20% over the conventional type of cut-off.

Machines built in various sizes to handle from 1/16" up to 3/4" diameter, and 1/16" to 5/8" square or equivalent area in hexagon and flat.

Exclusive Representatives

EAST: Penn Machinery Co., 117 North Third Street, Philadelphia 6, Penn.

MIDDLE WEST: Steel & Wire Machinery Co., 1017 Helmsdale Rd., Cleveland 12, O.

CENTRAL: Moslo Machinery Co., 2443 Prospect Avenue, Cleveland 15, Ohio.

WEST COAST: Hoffman & Heartt, 3005 So. Grand Ave., Los Angeles 7, California.

CANADIAN: Empire Engineering Co., 11 Wellington St. E., Toronto 1, Ontario.

CONTINENTAL EUROPE: Gaston E. Marbaix, Ltd., Devonshire House, Vicarage Crescent, London S. W. 11, England.

The LEWIS MACHINE Company
3441 E. 76th Street, Cleveland 4, Ohio

Also agents in Paris, Stockholm, Rotterdam, Brussels, Zurich, Milan, Bombay and Melbourne

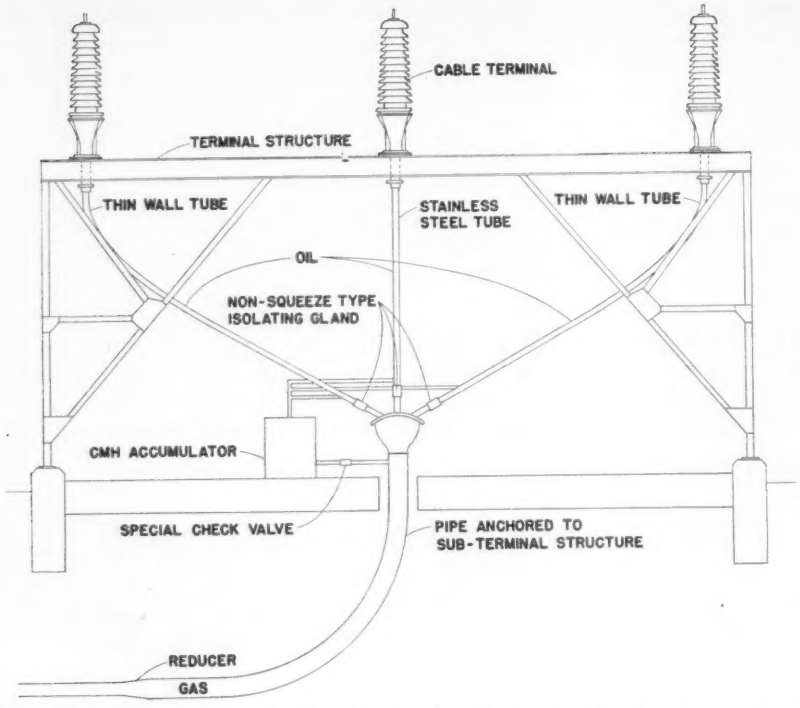
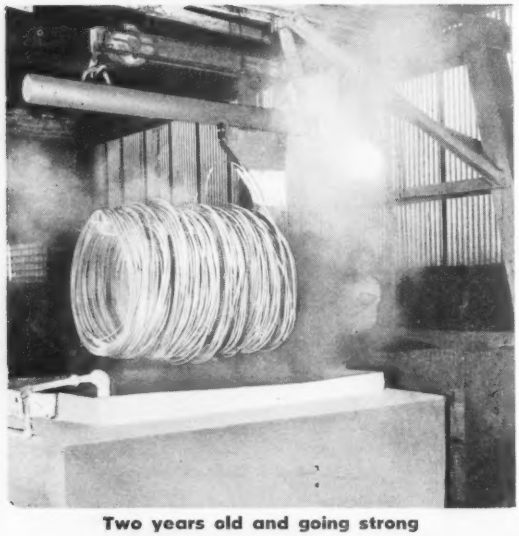


Fig. 9—Terminal Arrangement.

there are definite advantages to anchoring, as carried out at San Francisco, especially if modifications are made. There the pipe is kept from moving up or down relative to the terminal structure by bolts which fasten a collar or flange welded to the pipe to a concrete bed below. The pipe coating is accessible for inspection as the concrete does not surround the pipe. If the central riser tube which goes straight from the spreader to the base of the middle terminal were made of heavy walled non-magnetic steel, it would act as a structural member. Then if the pipeline ended in a reducer on a large diameter pipe, say 12″, just as it bent up to the terminal structure, conductor thrust forces would be absorbed. Such an arrangement makes for short riser tubes protected by the structure as compared to the long and more exposed riser tubes required by the free floating method. Fig. 9. In such an anchored system, the pipe can be allowed to expand or contract in a horizontal direction only.

★ ★ ★

For Pickling Hooks that Survive Severest Conditions



Two years old and going strong

get → LEWIS HAIRPIN HOOKS

Built for a minimum of 10 years of service. Construction protects work from acid drip. Hook shown at left showed no metal loss after two years of continuous service.

HERE IS WHAT ONE USER SAYS OF THEM:

The Lewis Welding & Engineering Corporation
Bedford, Ohio

Att: Mr. Richard D. Durrett, Sales Mgr.

Subject: Pickling Hooks

Dear Mr. Durrett:

I believe you will be interested in knowing of the performance of your acid pickling hooks.

We have had them in continual operation for better than two years. We have been well pleased, both with their "rugged" build and with the exceptional low metal loss of the pickling hook.

Sincerely yours,

MANAGER ROCK FALLS PLANT
RUSSELL, BURDSALL & WARD BOLT AND NUT CO.

Complete engineering data on request

THE LEWIS WELDING & ENGINEERING CORP.

Engineers · Designers · Fabricators · Machinists

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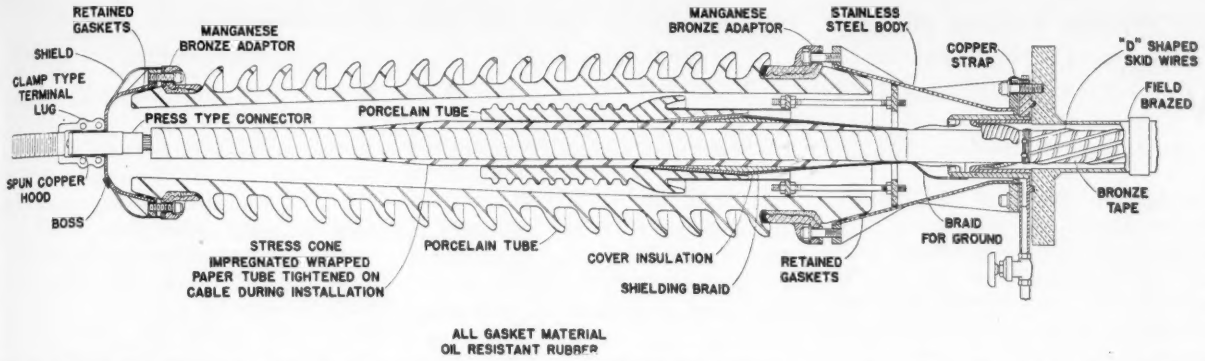

Fig. 10.—Simple high pressure terminal for 161 Kv.—Courtesy G & W Electric Specialty Company. * * * * * * * *

Terminals

THE design can be very simple and foolproof if the porcelain is allowed to carry the 200 psi pressure as with the 1931 Compression Cable and 48 subsequent installations abroad, including an experimental installation at 264 kv. Attempts were made in England and Switzerland to use an inner tube to carry the pressure, but leakage or failure always resulted. In any case the design was more complicated and expensive. An excellent design of great simplicity in which the porcelain carries the pressure is shown in Fig. 10. It is giving satisfactory operation in the New York 138 kv. installations.

* * *

This article will be published in two Parts. The second Part will appear in the November 1950 issue of WIRE AND WIRE PRODUCTS.

Note:—The bibliography and references will be published at the end of Part II.

* * *

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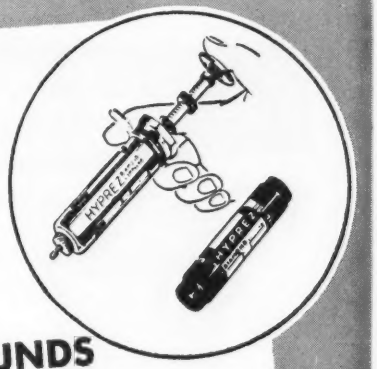
Your Order Now

for the

1950 Wire Buyers Guide

faster, finer finishing of WIRE DIES AND TOOLS with HYPREZ DIAMOND COMPOUNDS



A Difficult Die Hyprez Finished To Perfection

- Smooth, flawless surfaces
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- Proven time-saving techniques
- Quick economical results
- 26 engineered grades
- From rough to mirror polish
- 2 unit sizes — 18 and 5 gram
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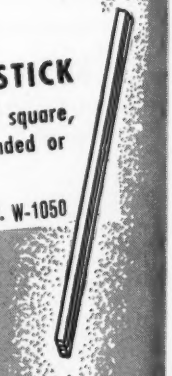
Only HYPREZ Can Do a HYPREZ Job!

Write for free HYPREZ LAMINATED LAPPING STICK

Available in 6" length, 1/8" to 3/16" square, and rectangular. Any size may be rounded or pointed for fine detail.

For free demonstration or Hyprez lapping stick write Dept. W-1050



HYPREZ DIVISION
ENGIS EQUIPMENT CO.
431 S. Dearborn St. Chicago, Ill.

Western Insulated Wire Company's New Location

WESTERN INSULATED WIRE CO. is now in operation at its new location, 2425 E. 30th St., Los Angeles 58, California. The $500,000 factory will be devoted to manufacture of Neoprene and rubber-jacketed portable cords and cables, asbestos insulated wire and cables, and miscellaneous cords, fixture and communication wires and cables.

★ ★ ★

New Bulletin on Improved Plow Steel Wire Ropes

A NEW bulletin is expected to fill a long desired need for quick reference of all information pertaining to Improved Plow Steel wire rope. All sizes and construction classifications are combined in one large table. This is probably the first time that this data has ever been assembled in this manner. Several changes have been made in information which has been brought up-to-date in this latest bulletin.

★ ★ ★

THIS bulletin available from **Macwhyte Company** is called Monarch Whyte Strand Bulletin No. 50-25. It is four pages, 8½ x 11, and contains information on how to order wire rope, and explains and describes wire rope constructions. A copy of this new bulletin may be had by writing to Macwhyte Company, Advertising Department, Kenosha, Wisconsin.

★ ★ ★

Carboloy Advances Three

APPOINTMENTS of **J. E. Weldy** as Marketing Manager, **J. S. Gillespie** as Product Sales Manager and of **J. M. Bertotti** as Field Sales Manager have been announced by K. R. Beardslee, President, **Carboloy Company, Inc.,** Detroit.

★ ★ ★

AS Marketing Manager, J. E. Weldy will be responsible for all sales, merchandising and other marketing activities for both carbides and special metals. Weldy joined Carboloy in 1930 at the Cleveland die works and by 1948 had risen to Sales Manager.

★ ★ ★

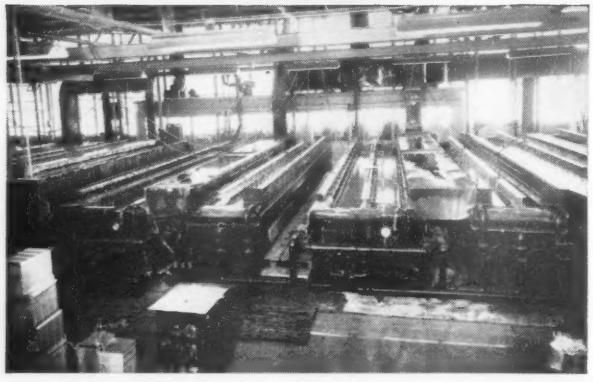
GILLESPIE joined Carboloy in 1936 in the engineering department. In 1948 he was named Manager of Tool and Wear Parts Sales Engineering after serving in several Carboloy district offices. In his new capacity he will be directly responsible for technical selling operations on dies, tools, wear parts and mining equipment.

★ ★ ★

AS Field Sales Manager, Bertotti will be in charge of Carboloy's district sales organization, distributor and jobber sales activities, and the company's customer training program. Bertotti, who joined Carboloy in 1943, headed the customer training school for four years and had been advanced to assistant sales manager of the company prior to his new appointment.

★ ★ ★

This Program Gives You
PERMANENT PROTECTION *Against Corrosion*
During METAL FINISHING!



To help you *permanently* control corrosion of equipment used for metal finishing, Haveg Corporation offers you this 2-point program:

1. Personal cooperation in the engineering and installation of Haveg tanks and other equipment
2. Complete manufacturing facilities to mold Haveg equipment to fit your individual needs

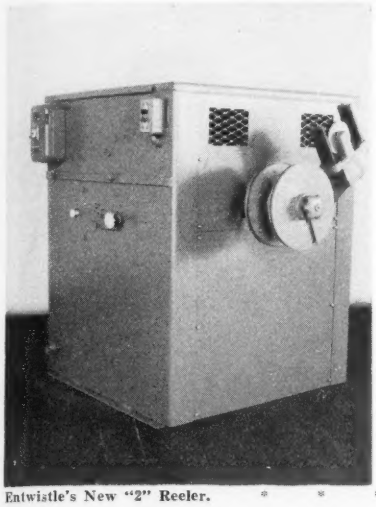
This means a *permanent* solution to your corrosion problems during metal finishing. That's because molded plastic Haveg is resistant throughout its entire mass to practically all solutions used for finishing metals. Moreover, you have equipment virtually tailor-made for longer service life, improved production. Many standard shapes available—including tanks, piping, fittings, valves, etc. Write for new Haveg Engineering Bulletin F-6.

HAVEG CORPORATION
NEWARK 47, DELAWARE
FACTORY: MARSHALLTON, DEL. · TEL. WILMINGTON 3-8884
CHICAGO 11 · CLEVELAND 14 · HARTFORD · HOUSTON 6 · DETROIT 11 · LOS ANGELES 13 · SEATTLE 1

J. L. E. Class Q Reeler

THE JAMES L. ENTWISTLE COMPANY has developed an ideal take-up which features a traversing reel for reeling or coiling flat wire or narrow strip stock.

★ ★ ★



Entwistle's New "2" Reeler.

AMONG the outstanding features of this new reeler is the smooth, even traversing action of the reel, which is infinitely adjustable for wire lay and reel width. Also, the fixed wire guide has a double, adjustable set of vertical rolls with a single horizontal roll providing perfect winding conditions. The reel is available with dependable coiling reels; also available in variable, constant-reel-shaft speed or with compensating drive for winding from a Capstan Machine.

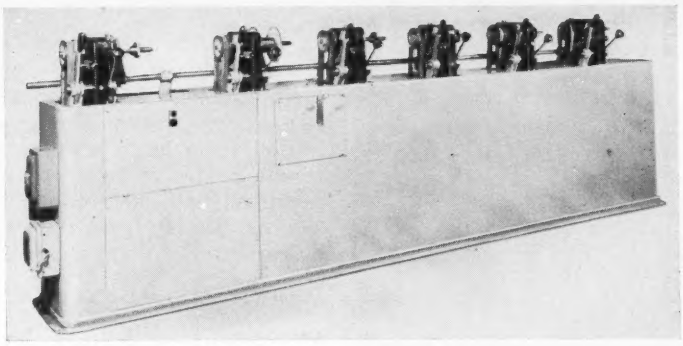
★ ★ ★

FULL information can be obtained by requesting Cat. Sec. 4J-1 from the James L. Entwistle Company, 43 Church Street, Pawtucket, R. I.

★ ★ ★

New Wire Stripper Fast and Efficient

ILLUSTRATION shows one model of new Wire Stripper, as equipped with vacuum base. Many other types are made, together with a variety of special attachments and coil holders to facili-



NO. 1900K MULTIPLE SPINDLE SPOOLER

This spooler is outstanding for its many unusual and desirable features.

Takes spools up to 16" flange diameter. Enclosed type, with mechanism readily accessible from rear side. Spindles mounted on ball bearings and each may be stopped or started individually. Uses Worthington All-Speed Drive unit.

All Emory Spoolers supplied standard or equipped to meet customers' special specifications.

On Spooling problems, consult

ROBERT J. EMORY COMPANY

31 EAST RUNYON STREET NEWARK 5, NEW JERSEY

DIAMOND DIES

There must be a good reason why

FORT WAYNE WIRE DRAWING DIES

are bought in such large volume.

Fort Wayne Wire Die quality starts with carefully selected diamonds. These are drilled and finished by expert die specialists on the most modern die-making equipment. Is it any wonder that FORT WAYNE WIRE DIES are in great demand throughout the country!

Prices are reasonable because of large-scale raw material buying and efficient production methods. Are you a FORT WAYNE WIRE DIE customer?

Write us today for information. To try FORT WAYNE WIRE DIES is to be convinced.

FORT WAYNE WIRE DIE, INC.

2625 East Pontiac Street

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SALES UP 250%
SINCE 1947!

There MUST Be A Reason—

WHY MORE AND MORE INSULATED WIRE MANUFACTURERS USE
NEW ENGLAND LACQUER

—And There Is!

1947 1948 1949 1950

NEW ENGLAND LACQUER
. . . is tailor-made to your special requirements! Heat-Resistant—Flexible — Flame-Proof — Clear — High Dielectric Retention.

Consult us on all coating problems.

NEW ENGLAND LACQUER CO.
KING PHILIP ROAD
EAST PROVIDENCE, R. I.

tate high production wire stripping.

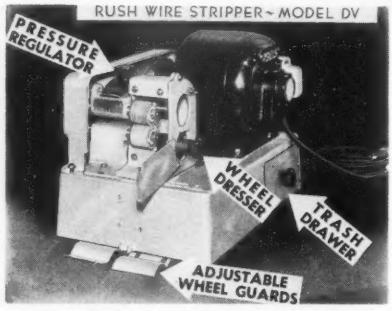
* * *

ALL models use principle of frictionally generated heat to melt Enamel and Formex Type Insulations. Through proper selection from large number of different grades of stripping wheels, practically all kinds of insulations can be cleanly removed without damage to the wire.

* * *

IT permits mechanical stripping where hand methods were formerly thought the only safe way. Some users claim to have increased production as much as 400% over former methods. Model shown will strip wires, gauges 48 through 25, including Litz Wire up to 50/44. Stripping wheels may be resurfaced or dressed as they wear, thus keeping wheel costs to a minimum.

* * *



One New Rush Wire Stripper. * * *

STRIPPER shown is 10″ wide, 15″ deep, and weighs 38 lbs. complete with motor and 6′ lead wire.

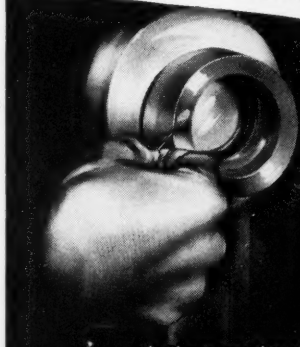
* * *

THE strippers are available for outright purchase or may be had on a rental-test basis, permitting new user to determine on own production lines, the actual cost of operation and savings which may be expected. Rentals paid are applicable to purchase price. Without special attachments and stripping wheels, stripper shown is priced at $225, f.o.b. factory. Other models are priced as low as $150.

* * *

BOTH strippers and stripping wheels are manufactured ex-

YOU CAN FINISH CARBIDE AT LOWER COST!



In the operation shown here, a carbide drawing die is being polished to a long life mirror finish in less than 10 minutes with Elgin Dymo Diamond Compound. Grade 14 is used to size and pre-polish the die followed by Grade 6 for mirror polishing. The die rotates at 2200 r.p.m. Soft copper polishing tools and wood sticks are used to apply the compound.

ELGIN DYMO
DIAMOND COMPOUND

Elgin Dymo works faster and goes farther because precision graded particles of pure diamond, assisted by an exclusive Elgin vehicle, do the cutting. Elgin Dymo excels in actual shop convenience, too! It comes ready to use, each grade distinctly colored for instant identification, and it is universally soluble to simplify clean-up after polishing.

See how Elgin Dymo . . . available in 11 Bureau of Standards grades for any lapping or polishing job . . . will reduce your finishing costs and give you better results at the same time. Just mail coupon below for a free demonstration right in your own plant!

---MAIL THIS COUPON TODAY---

Yes, I'd like to see how Dymo can cut our finishing costs.

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POSITION _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

INDUSTRIAL PRODUCTS DIVISION
ELGIN NATIONAL WATCH CO.
ELGIN, ILLINOIS

YOU CAN BUNCH

small diameter

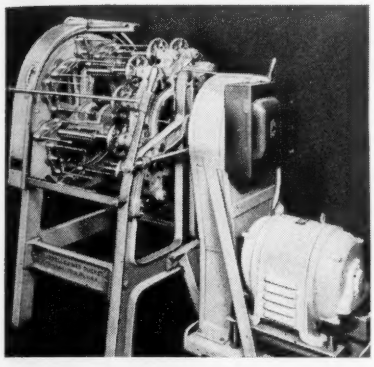
WIRES

on the SINGLE-TWIST PRINCIPLE — Assuring

PERFECT BALANCE and EVEN BUNCH

with this

12-Spindle Horizontal Buncher



Like all H-D equipment, this machine reflects more than 80 years of "know-how" combined with the most advanced technological developments. We can help you solve many of your production problems. Write our engineering department today. This may be your first step to increased efficiency.

The limits of the twisted bunched diameter are .012" to .030" The flyer speed is 2000 R.P.M. All flyers and spindles are ballbearing mounted.

TAKE-UP SPOOL. 5" diameter x 4" traverse x 2¾" barrel. Protected capacity 10.5 lbs. Automatic adjusting tension control.

TWIST RANGE. Capstan controlled overall range 1.0" to .10" lay. Individual machine range 3.3 to 1 ratio of above. For example—.15 to .50 inch lay.

DRIVE. Motor drive with clutch pick-up for controlled starting.

FLOOR SPACE. Machine 5' 6" x 3' 6". Creel space depends on maximum number of wires being bunched.

FOOTAGE COUNTER. Can be installed to stop the machine at predetermined footage requirements.

POSSIBLE USES. The machines are being successfully operated on Litz Wires that fall within the range of the machine, Fourdrinier Wire and many specialties where a precision bunch is required.

HASKELL-DAWES MACHINE COMPANY, INC.

Wire Bunchers, Wire Stranders, Special Twisters, Tubing Twisters, Cordage Formers and Layers.

2231 E. ONTARIO STREET

PHILADELPHIA 34, PA.

Cable Address "DAWCO" Philadelphia

clusively by the **Rush Wire Stripper Division of The Eraser Company, Inc.,** 140 So. State St., Syracuse 2, N. Y.

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THE smart man keeps abreast of developments among suppliers by keeping close tab on the advertising. Advertisers are concerns who are alert, progressive and with reputations to sustain. You can trust them.

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THE smart alec is one who doesn't need to know what's going on. He thinks he "knows it all." He buys on price and considers himself shrewd. His sources of supply are often pig-in-a-poke concerns, with nothing behind them.

★ ★ ★

READ the advertising, patronize the advertisers and you can be sure of good products for your self and your employer.

★ ★ ★

H. W. Steinkraus Marks 25th Anniversary with Bridgeport Brass Co.

HERMAN W. STEINKRAUS, immediate past president of the United States Chamber of Commerce and president and chairman of the board of directors, **Bridgeport Brass Company,** has been presented a 25-year pin marking his association with the company since August 18, 1925.

★ ★ ★

MR. STEINKRAUS became sales representative of the company in the Cleveland area, where he originally started his business career with the Osborn Manufacturing Company. He was general sales manager of the firm when he resigned to establish his own chemical and metal manufacturing company.

★ ★ ★

THE Bridgeport Brass eventually bought out his concern and after a year's assignment as Cleve-

STANNOCHLOR

an outstanding

chemical

STANNOCHLOR— anhydrous stannous chloride — assures improved immersion tinning; better, more uniform results for a score or more of other applications.

This oustanding chemical product, developed by M & T, is efficient and economical to use. It is highly stable and does not deteriorate with age. It contains no water of crystallization — so goes further per pound.

Investigate Stannochlor — or, if tin in any form has a place in your manufacturing or processing, come to headquarters. We'll be glad to discuss your problems.

METAL & THERMIT CORPORATION

100 EAST 42nd STREET, NEW YORK 17, N. Y.

Specialists in Tin

Product of MODERN SCIENCE and MASTER CRAFTSMANSHIP

PHILIPS

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DIAMOND DIES

● The tools of modern science are combined with the skills of the master craftsman in the production of PHILIPS *master-made* Diamond Dies.

Every diamond selected for cutting is examined by PHILIPS X-ray diffraction apparatus to determine the proper direction for drilling to provide longer life and greater satisfaction to the user. Master craftsmen of long experience, working under the most modern conditions, drill each diamond to precision tolerances. Result? The finest diamond dies obtainable—now available to American industry under the trade name of NORELCO Diamond Dies.

All sizes . . . from .000275 to .100 are available at competitive prices. Let us consult with you concerning your requirements.

Norelco

NORTH AMERICAN PHILIPS COMPANY, INC.

Dept. FE-10, 100 East 42nd St., New York 17, N.Y.

land sales representative transferred him to Bridgeport as sales manager of the local plant. He was later promoted to vice president in charge of sales, to membership on the board of directors and later became manager of the company. In 1941 Mr. Steinkraus was named vice president and general manager. He became president of the Bridgeport Brass Company in 1942 and chairman of the board in 1946.

* * *

UNDER the supervision of Mr. Steinkraus the company became one of the largest brass manufacturers in the world. During World War II the company established a plant in Indianapolis, Ind.

* * *

New Packaging for Cable Developed by Reynolds Metals

USERS of aluminum cable for electric transmission lines will save an average of one-half cent

Reynolds New Master Coils. * * *

per pound through a new packaging method has been announced by **D. P. Reynolds,** Vice President and Manager, General Sales Division, **Reynolds Metals Company,** Louisville, Ky. It is said to be the first significant advance in 50 years in the distribution of aluminum cable.

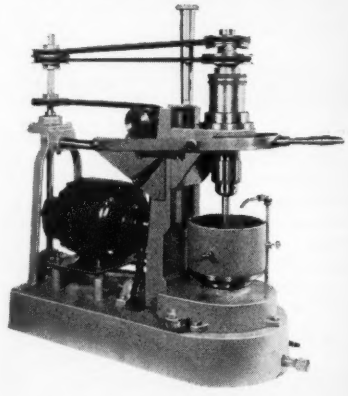
* * *

THESE "Master Coils," containing a full 1000 pounds of cable, are shipped without the customary reel. This eliminates the nuisance of keeping track of reels and the expense of returning them. . . . $3.50 - $7.00 per reel. It also eliminates reel breakage, and

NEW!

ROOS

Industrial Type LAPPING or RIPPING MACHINE for Tungsten Carbide LARGE DIES



- Capacity up to 5" die casings.
- Chuck capacity 3/8" to 3/4" lapping pins.
- New "V" Type drive belts.
- 1/2 H.P. motor.
- Famous Roos revolving table for efficiency and time saving.
- Prompt delivery schedule.

ROOS TOOL & MFG. COMPANY

33-35 Bloomfield Avenue, Newark, N. J.
Factory—
17-19 Grove St., Montclair, N. J.
(Suburb of Newark)

Also Distributed by Carboloy Company, Detroit, Mich., and Canadian General Electric Company, Toronto, Can., or your Die Room Supply dealer.

expense borne by the user.

★ ★ ★

THE Master Coil is protected by heavy cardboard core and end plates, a paper wrap and overall wood lagging, all securely bound together by metal straps. Tests show it can be dropped to the ground from freight car or truck without damage.

★ ★ ★

IN the field, the lagging and outer wrapping are removed and the coil assembled on a Master Reel by removing one of the reel flanges, inserting the hub into the coil, and attaching the removable flange. When empty, another coil is assembled on the same Master Reel. Three or four master reels will take care of stringing any line, can be used over and over again, and need not be returned.

★ ★ ★

Aetna-Standard Plans to Expand and Move Offices

ERNEST E. SWARTSWELTER, President and Board Chairman of **The Aetna-Standard Engineering Company,** Youngstown, Ohio, has announced a new expansion program, and transference of offices and personnel from Youngstown to Ellwood City, Pennsylvania, during the summer of 1951. This will affect approximately 153 families presently living in Youngstown. All business currently conducted in Youngstown will then be carried on in Ellwood City, save for executive management and sales operations. Some twenty Aetna-Standard families will move to Pittsburgh where management and sales activities will be conducted in closer proximity to many of Aetna's customers.

★ ★ ★

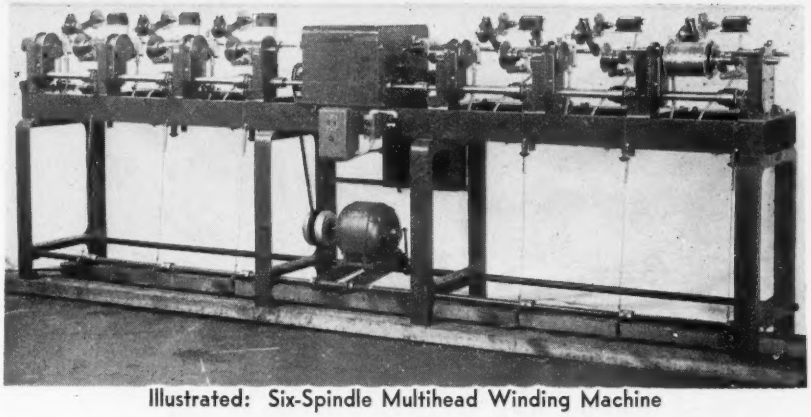
Office space in Youngstown will be relinquished and new offices set up in an Ellwood City building formerly owned by the National Tube Company. It will soon undergo extensive remodeling.

★ ★ ★

ANNOUNCED also is a second important move, Aetna's entry into the rubber and plastic indus-

MACHINERY FOR WIRE

WINDING · SPOOLING · COILING



Illustrated: Six-Spindle Multihead Winding Machine

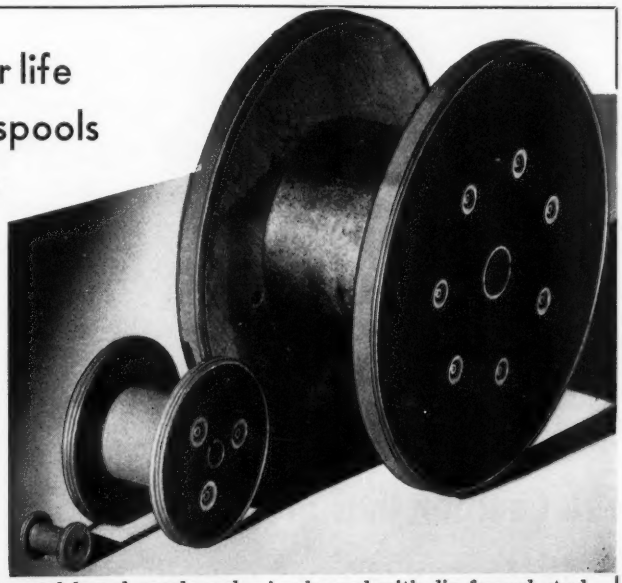
The Winder shown above has a main control box with a single screw reversed by a solenoid control for traverse of wire guides. Each head individually controlled by a pre-determined measuring device.

Send for information on this winder and our complete line of BOYD-FIDELITY SPOOLERS

BOYD & SONS MANUFACTURING CORPORATION

1434-38 Callowhill St., Philadelphia 30, Pa.

for longer life shipping spools and reels



Hubbard metal bound spools and reels for shipping are ruggedly built to withstand all the shock and impact normally found in transporting spooled wire. Head is plywood with die formed steel tire. Design provides a light weight spool or reel with long wear life. Write for information and prices.

Hubbard

HUBBARD SPOOL COMPANY
1624 Carroll Ave., Chicago 12, Ill.

STEEL SPOOLS AND REELS . . . METAL BOUND SPOOLS AND REELS . . . STEEL TRAVERSES . . . LIGHT WEIGHT REELS WOOD REELS

Hair Pin Hooks

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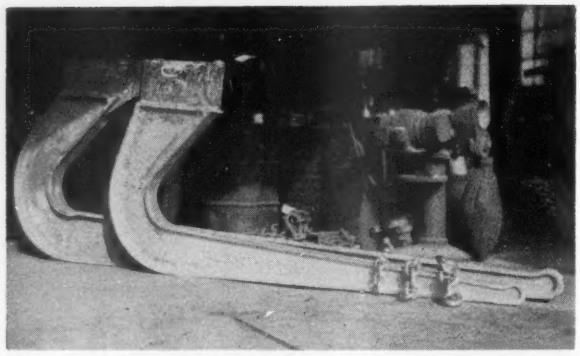
for Pickling Coils



We make them in all sizes of our "Albro" Acid Resisting Metal

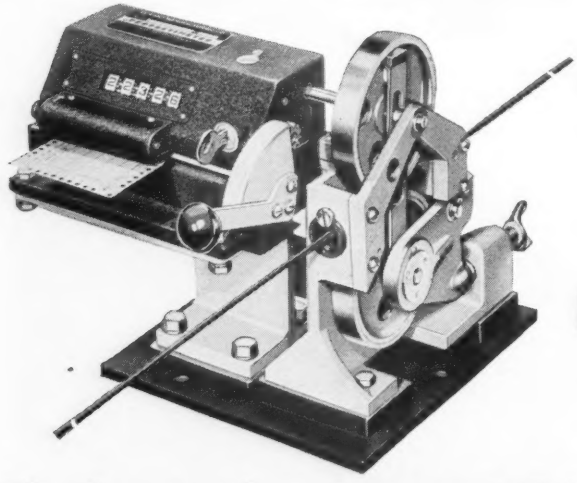
The same metal as our time proven "Albro" Die Cast Acid Resisting Chain.

ALBRO METAL

BRONZE DIE CASTING COMPANY

Franklin St. at Ohio River, N. S. Pittsburgh 33, Pa. Tel.: CEdar 1-5987-8

For Pickling—Chains—Hooks, Clevices, Bolts, Crates.



NEW "PVR" on Wire Measuring Machine

The Counter that gives you a Printed Record

RESULTS PROVE . . . . .

- **INCREASED PRODUCTION** — no time wasted by operators in writing figures.
- **COST SAVINGS** — true measurement is always recorded.
- **ELIMINATION OF COSTLY MISTAKES** — printed figures cannot be misread.

Send for Bulletin PVR

DURANT MFG. COMPANY
1918 N. Buffum St. 118 Orange St.
Milwaukee 1, Wis. Providence 3, R. I.
Representatives in Principal Cities

The quick lever reset on this new "PVR" Productimeter enables operators to produce more per day. Savings over a short time more than justify installation costs. Investigate NOW.

Durant Sales Engineers will be glad to demonstrate.

PRODUCTIMETERS
SINCE 1879
Speedometers OF INDUSTRY

tries through association with Hale & Kullgren, Inc., Akron, Ohio, rubber and plastic machinery consultants.

★ ★ ★

IN the past, Aetna's Warren, Ohio, plant built most of the company's flat rolled finishing equipment. Now, the Warren plant assumes greater importance in that it will build rubber and plastic industry equipment to specifications furnished by the Akron firm. Aetna does not intend to have its Warren plant build existing types of machinery, such as mills, calendars, etc., but will erect more or less revolutionary types of equipment built to satisfy current needs of the two industries mentioned. In addition to pioneering work, the Warren plant will also do considerable work in rebuilding Bandbury mixers.

★ ★ ★

Continental Steel Establishes New Office

CONTINENTAL STEEL CORPORATION, Kokoma, Indiana, announces the appointment of **Byron L. Smith** to the new position of district sales manager for the territory consisting of Kansas, Nebraska, Oklahoma and western Missouri with headquarters in Kansas City,

★ ★ ★

MR. SMITH has been associated with Continental Steel for almost fifteen years. He was a sales representative in the Chicago area for three years, a sales representative in Missouri for four years, and for the past six years he has been located in Oklahoma City as sales representative for Oklahoma. Mr. Smith's new Kansas City address will be announced shortly.

★ ★ ★

Heanium Wire Guides

HEANIUM, a material well-known in many fields as the "Ceramic Jewel" has now been introduced and favorably received as a new and improved wire guide substance.

★ ★ ★

THE near-diamond hardness of Heanium is the reason for its successful resistance to wear and abrasion. Long recognized as a

superior textile guide, Heanium wire guides are giving equally satisfactory performance.

★ ★ ★

SIZING, straightening, twisting are only some of the operations in which Heanium guides are used. In some instances, drawing dies are made in Heanium. In addition to their resistance to wear, they are not affected by chemicals, alkalies or heat. They can be supplied polished or unpolished as required.

★ ★ ★

INQUIRIES are welcomed and samples are available when requested. For further information write **Heany Industrial Ceramic Corporation,** 915 Whitney Ave., New Haven, Connecticut.

★ ★ ★

Prestressed Concrete

(*Continued from page* 884)

combined with shear stresses will result in compressive principle stresses. Or, in other words, the designer is enabled to control the direction of the principle stress trajectories.

★ ★ ★

Significance

AFTER this rather elementary explanation you are able to grasp the real **significance** of prestressed concrete.

★ ★ ★

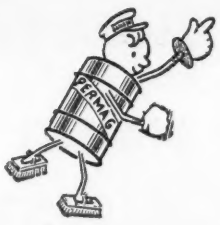
HIGH grade steel and concrete which today are available can be utilized fully in prestressed concrete construction whereas in ordinary Reinforced Concrete Construction the use of high carbon steel is, due to the danger of cracking, impossible.

★ ★ ★

THE use of high quality materials and higher stresses in turn makes possible smaller construction heights or larger spans for girders with the corresponding saving in dead loads.

★ ★ ★

THE prestressed structural member is crackproof and can, therefore, within certain limits, be designed as being made of a **homogeneous** material; and not only homogeneous but also an **elastic**



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DEPENDABLE SUPPLY
PRODUCT UNIFORMITY
OPTIMUM PERFORMANCE

PERMAG Drawing Compounds

In Use Over 27 Years
The Proper Type for Your Work
Satisfaction Proved by Performance

To Know-Write or Wire NOW

—FOR INFORMATION
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Magnuson Products Corporation

50 Court Street Brooklyn 2, N. Y.

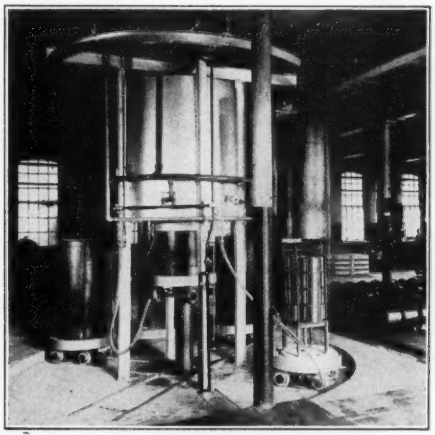
Nationally Represented

In CANADA: Canadian PERMAG Products, Ltd. Montreal, P. Q.

"The Most Efficient Furnace I Ever Used"

Says One Copper Wire Man* of the Kenworthy "DRINOX" Bright Annealing Furnace

* Name on request



Bright annealing furnace for wire, strip, stampings, etc.

The particular type referred to is the 50 K.W. dry type copper wire annealer capable of handling 15,000 to 20,000 lbs. of wire in 24 hours, depending on the size of coils or reels placed in the furnace.

Kenworthy "Drinox" bright annealing furnaces are made in a full range of capacities to meet most every production requirement.

Gas or electric heat.

Furnished with "Drinox" atmosphere gas converter if desired.

KENWORTHY

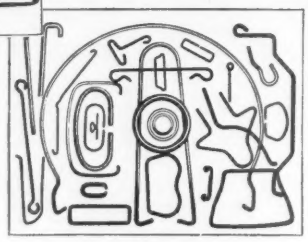
50th ANNIVERSARY

CHARLES F. KENWORTHY, Inc.
193 PIEDMONT STREET
WATERBURY 6, CONN.

Bent on Economy?

ANY SHAPE!

ANY AMOUNT!



Make them on a NILSON 4-Slide Machine and give yourself VERSATILE WIRE or METAL FORMING at its peak . . . high rate one-operation production . . . close tolerance . . . low cost . . . all from coiled stock.

See also NILSON Wire Straighteners and NILSON Stationary and Tilting Wire Reels.

Write for pamphlet "W."

THERE'S NOTHING LIKE A NILSON

The A. H. NILSON MACHINE CO.
BRIDGEPORT 5, CONN.

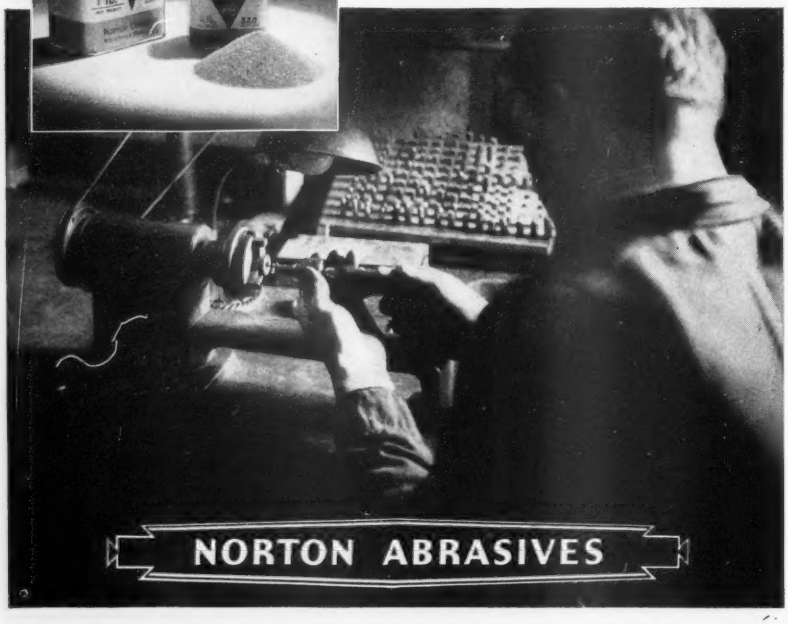
Automatic Wire and Metal Forming Machines • Staple Forming Machines • Chain Making Machinery • Foot and Power Presses • Wire Reels • Wire Straighteners.

SPECIALISTS IN WIRE FORMING EQUIPMENT FOR OVER 50 YEARS

NORBIDE Abrasive: Effective Economical

This abrasive—second only to the diamond in hardness and 150 times less expensive—does an efficient job of cutting and semi-finishing cemented carbide wire drawing dies.

NORTON CO. — Worcester 6, Mass.



material with a high degree of resiliency. This has been demonstrated by many tests in which the working load and cracking load have been exceeded and where the cracks after removal of the excess load have closed and disappeared completely.

* * *

History of Development

THERE is of course a considerable history to the development of prestressed concrete. There is not sufficient time today to dwell very long on this subject.

* * *

ONE of the pitfalls of early attempts at prestressing was the use of ordinary mild reinforcing steel. After a few months all prestress was lost due to the shrinkage of concrete and due to what is now known as "plastic flow" of concrete.

* * *

THE magnitude of these steel stress losses has now been established through research to be within certain limits. Steel stress losses of from 20 to 40,000 psi may have to be considered. The use of high carbon wire steel with a .2% yield point of over 200,000 psi makes it possible to allow in the design for a sufficiently large stress loss. For example, the wire furnished to us for use on the Walnut Lane Bridge in Philadelphia could be stressed initially to about 150,000 psi. For poststressing methods and using this type of wire for girders a stress loss allowance of approximately 25,000 psi is adequate. This would, therefore, leave us with an actual working stress of 125,000 psi.

* * *

HIGH initial wire stresses are all the more justified as, during the prestressing operation, every wire is automatically tested to the maximum stress it will ever be called upon to sustain. It can easily be shown that the stress increment in the wire due to live load cannot exceed an amount corresponding to the live load strain in the concrete. Normally, this is in the neighborhood of say 6,000 psi.

However, this stress increase is more than offset by shrinkage and plastic flow losses long before the live load is applied. The initial wire prestress is, therefore, a maximum.

★ ★ ★

TODAY we have methods for prestressed concrete construction which are practical and economical not only in European countries but in this country as well. They are the result of many years of research and of many trials. These years were filled with the typical growing pains of a revolutionary development.

★ ★ ★

IT is well to realize that due to recent development of these methods prestressed concrete has become a reality within a relatively short time. A new material was born!

★ ★ ★

Future Development and Applications

I BELIEVE that the **future development** of prestressed concrete will be rapid, extensive and comparable to that of reinforced concrete itself. This development must be expected in two fields of Civil Engineering: in Construction and in Manufacturing of precast members.

★ ★ ★

IN the Construction Field prestressed concrete is used today for either straight structural members, such as bridge girders, airplane hangar spans, factory roofs, beams and slabs, or for circular structures such as concrete tanks, reservoirs, shallow spherical dome roofs and circular tunnels.

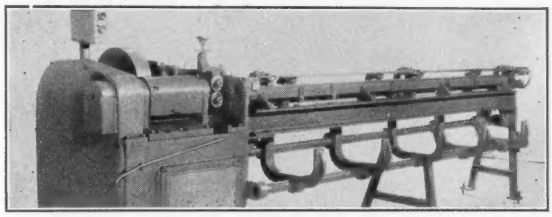
★ ★ ★

IN this country the most widely used method of prestressing of large circular concrete water tanks is what is known as a wire-winding machine. It consists essentially of a wire pulling die which travels around the tank on a motor-propelled carriage with friction cable.

★ ★ ★

NEW methods of **underpinning** with the use of prestressing have been developed and success-

WIRE STRAIGHTENING AND CUT-OFF MACHINES—
MECHANICAL OR HYDRAULIC CUT-OFF.



Capacity .040" Dia.—5/32" Dia. (All Wire) Illustrated

Model "A"—capacity .040"—.156"
Model "B"—capacity .120"—.250"
Model "C"—capacity .120"—.312"

HYDRAULIC AND AIR FORMING MACHINES.

DOUBLE, SINGLE, AND TILT TYPE REELS

NORSHOLM INDUSTRIES

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Rochester

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Michigan

Announcing

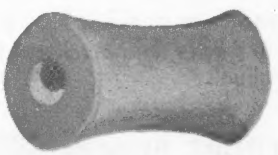
HEANIUM*

The Ceramic Jewel

Ranking next to the diamond in hardness.

WIRE GUIDES
for GUIDING, TWISTING
SIZING, STRAIGHTENING
AND OTHER MILL APPLICATIONS.

GIVES LONGER WEAR,
BETTER PERFORMANCE.



Shock, Heat, Abrasion Resisting.

Send for Detailed Information.

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NEW HAVEN, CONN.

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MANUFACTURERS OF

PRECISELY GRADED

DIAMOND POWDER

SERVING INDUSTRY'S

SPECIALIZED NEEDS

MEMBER

40 West 40th Street • New York 18, N. Y.

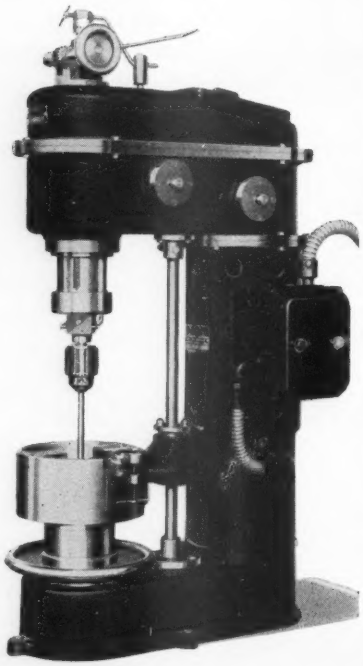
DIE RIPPING
(OR LAPPING)
MACHINE

Suitable for round, square, Hexagonal or shaped dies.

Accommodates die cases from 1⅛" to 4" diameter. (28 mm-100 mm).

Fitted with abrasive cup or self-centering chuck.

Needles or punches held by ½" capacity 3-jaw self-centering chuck.



GEORGE CROSSLEY, (LTD.)
ALBION IRON WORKS • CLECKHEATON
ENGLAND
* Please give details of electrical supply available.

fully used. Another interesting application is the vertical prestressing of gravity concrete dams and of the counterforts of multiple arch dams. This has been done in France on the Cheurfas Dam where vertical cables anchored to the rock foundation exert a force of 1,000 tons every 12 feet. Inclined prestress cables were used to similarly anchor the counterforts of the multiple arch dam of St. Michel in France. Instead of drilling into rock the latest development in this line is the sinking of shafts into rock formations for anchorage forces of as much as 20,000 tons.

★ ★ ★

MANUFACTURE of precast, prestressed members requires of course a certain investment in plant and is limited territorially within a certain radius of economic delivery. Successful methods are available for the manufacture of prestressed concrete pipe, prestressed concrete railroad ties, prestressed concrete or prestressed hollow tile joists and beams as well as prestressed concrete poles and masts. For all these applications a suitable prestressing wire must be available.

★ ★ ★

WE believe it is a challenge to the wire manufacturing industry to properly evaluate the important possibilities of prestressed concrete construction as a new market for high carbon wire. This brings us to the important question of wire specifications.

★ ★ ★

Wire Specifications

THE characteristics of the wire to be used in a specific project must be known when the design is made and when the method of prestressing and of construction is decided upon.

★ ★ ★

IT is, therefor, imperative that both the designer and the wire manufacturer have a clear understanding of the definition for those wire properties which are essential for prestressed design and which

must be controlled within reasonably close limits.

★ ★ ★

ALL too often ambiguous terms such as yield point stress, proof stress, elastic limit and creep limit are being used without explanation of their intended meaning. There still exists considerable controversy even among prestressed concrete designers as to the criteria which must govern the wire stresses during prestressing operations and under working load.

★ ★ ★

IN dealing with high carbon wire we have found it to be useful to describe wire by the following physical characteristics:

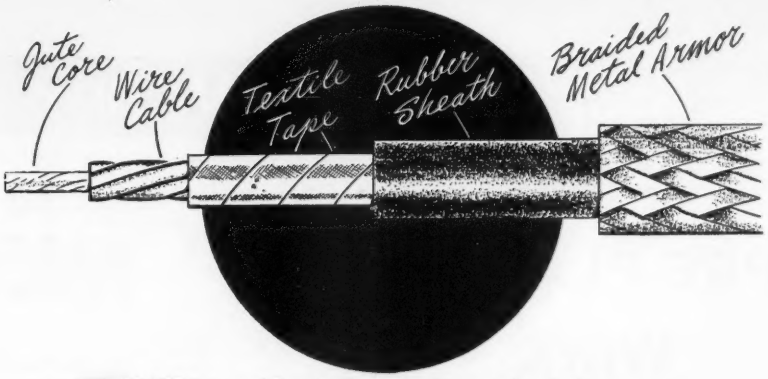
1) **"Ultimate tensile strength"**
2) **"Yield strength" at .2% offset**
3) **"Conventional elastic limit" corresponding to a point giving .01% offset; often called proof stress**
4) **"Limit of relaxation" as defined by the Belgian Professor, F. Campus, namely, the stress at which the long term creep of the wire in a constant length test does not exceed 1% of elastic deformation at that stress**
5) **"Ductility" measured by the elongation at failure in % of the original length and by the reduction of area in % of the original area**
6) **"Plastic set" of the wire produced by release of stress in the amount of a given stress differential from the "initial" stress down to "working" stress, measured in inches per inch**
7) **Long term "creep" of wire defined as the non-recoverable, plastic deformation of the wire in a constant length test produced by a given initial stress and measured in % of the initial elastic deformation**

★ ★ ★

SINCE the prestressing engineer is mainly interested in minimizing and controlling within known limits the inevitable losses of wire stress, he is confronted with the necessity of interpreting the elastic and plastic deformation as defined above in terms of stress. As a rule it is on the safe side to use the basic Young's modulus of elasticity for this purpose although this value decreases considerably in the higher stress regions of high carbon wire.

★ ★ ★

IN addition to these physical properties other important facts about the wire which must be known are the straightening or



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stress relief treatment, diameter of coils as delivered, diameter tolerances and the limitations of chemical composition of the wire. You will appreciate better than anyone else the importance of knowing, first, what is expected of a prestressing wire and, second, how well and how consistently can these requirements be controlled.

★ ★ ★

THE most important characteristic of a prestressing wire, outside of high ultimate tensile strength, is its stability. By this we mean the ability of the wire to permanently remain under a constant tensile stress when it is kept at a constant elongation and after the elastic deformations and the so-called "immediate" plastic deformations have taken place.

★ ★ ★

PROBABLY very few wire types are absolutely stable. Therefor the designer includes in his calculations a certain allowance for loss of stress due to long term plastic creep in the wire. However, the amount of this allowance varies considerably with the type of wire used and must be ascertained by test.

★ ★ ★

SO far, such tests have been conducted with a limited number of wire types mostly in the laboratories of a certain number of university professors who are interested in prestressed concrete. I should think, though, that it would be in the interest of the wire manufacturing industry to have independent test results available on the relaxation limit and on creep deformation above this limit for those wire types which are thought suitable for prestressing.

★ ★ ★

Prestressed Girders Vs. Pre-Stressed Tanks and Pipes

TODAY prestressing of concrete is applied mostly either to straight structural members such as girders and beams or to large circular liquid containing tanks or concrete pressure pipe.

★ ★ ★

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IN the first case the prestressing wires are stretched to the desired elongation by means of special jacks and are fixed at the girder ends by anchoring devices which usually are subject to patent protection.

★ ★ ★

THE prestressing of circular structures, on the other hand, is accomplished in the most efficient and most economical way by horizontally wire winding a concrete core wall with a continuous and uniformly stressed high carbon wire. This operation is performed by a wire winding machine which in the case of tank structures, is suspended from the top rim and which propels itself around the wall on a traction cable or chain. The stressing of the wire is accomplished by this machine by drawing it through a die of such dimension as to produce the desired stress. This method has been developed by the Preload Corporation and has been successfully used on over 500 circular tank structures.

★ ★ ★

A SIMILAR procedure is used for prestressing of concrete pressure pipe. In this case the pipe core is placed in a vertical position on a turntable and the stressing die through which the wire is fed moves slowly up on a stationary guide rail in accordance with the required wire spacing.

★ ★ ★

VERTICAL prestressing in tank structures and longitudinal prestressing in pipes is accomplished with groups of straight wires in a similar manner as used for girders.

★ ★ ★

Economic Advantages

THE savings in steel and concrete quantities made possible by prestressing are considerable. As an example we used the steel and concrete quantities for the walls of nine sludge tanks at Hunts Point for the City of New York for which the Preload Corporation has been awarded a contract. If

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compared to the quantities of the conventional reinforced concrete design the prestressed tank walls show a saving of 41% in concrete and a saving of 79% in steel. While the prestressing wire in place is necessarily more expensive than ordinary reinforcing steel, only 1/5th of the tonnage is required so that the cost ratio is still very favorable.

★ ★ ★

Conclusion

IN conclusion, may I state that we believe that prestressed concrete is here to stay. Its field of applications grows consistently and rapidly.

Prestressed concrete is not just a new process but in its various applications it can almost claim to be a new basic material.

Important progress has been made in the last 5 years in the art of applying the basic prestressing principle in a practical and economical way but further developments are pending and many possibilities are still unexplored.

It seems to us that the wire manufacturing industry can develop an important market in this field by making available prestressing wire with basic properties suitable for the purpose.

★ ★ ★

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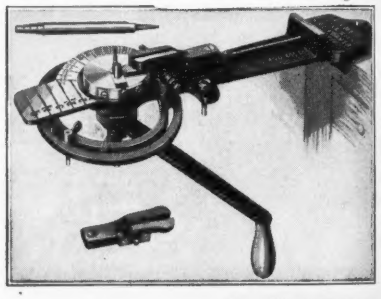

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Neoprene Jacketed Telephone Wires

(*Continued from page 833*)

reduced approximately 35%. An analysis of the causes of drop wire troubles over this period shows a marked decrease in those caused by abrasion and by deterioration of the outer protective covering. In fact, due to the greatly reduced number of troubles from these causes, wire breakage, formerly considered only a minor cause of trouble, is now classed as one of the major causes.

* * *

THE degree of improvement which may be expected in working drop wires can be determined more accurately by observation of such wires in special service trials when individual records are kept on their performance. Trials of this nature which have been carried on with the earlier neoprene jacketed wires for approximately 9 years have shown no cases of trouble except those due to breakage and these have appeared to be unavoidable since the majority were caused by hurricanes or by falling trees and branches.

* * *

Adoption of Neoprene Jackets in Other Wires

THE excellent performance of neoprene jacketed drop wire in the early service trials led to adoption of similar constructions in all of the other wires used in outdoor telephone distribution. Most of these wires are not required to be supported in aerial spans and consequently they do not need the cotton reinforcement between insulation and jacket which is provided in the drop wires. The jacket consequently is placed directly over the individual insulated conductors. Such wires include Bridle Wire, which is used for making connections between insu-

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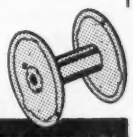

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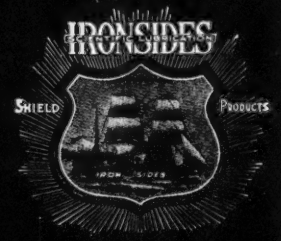

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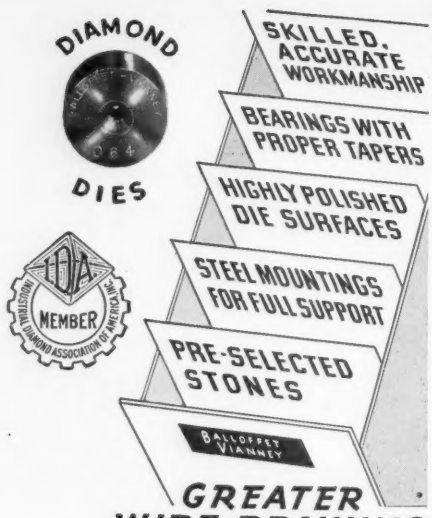

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lated wire and open wire, and Block Wire, which is used for making connections between protected cables and subscribers' stations where the wire can be run through rings installed on the rear walls of buildings. Other types include Restoration Wire, which is used for emergency restoration of open wire circuits when they are put out of service during plant alterations or by storms, and Tree Wire, which is used for insertion in open wire circuits where it is necessary to insulate the wire from grounding contacts such as by tree branches.

* * *

ALL of these wires need the type of protection for the insulation which is provided by neoprene jackets and while these wires are not used as frequently or in such large quantities as drop wire, they are just as essential to proper functioning of the telephone plant. All observations of the performance of these wires up

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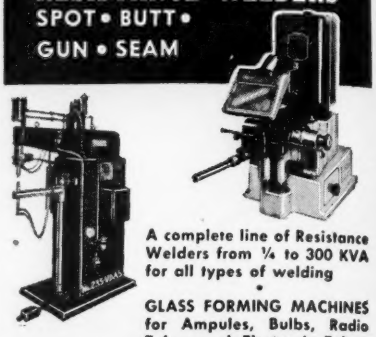

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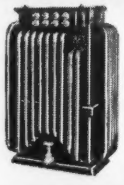

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to the present time indicate that they are a considerable improvement over the braid covered wires which they replaced.

★ ★ ★

Conclusion

THE general adoption during the the past 5 years of neoprene jacket as a replacement for weatherproofed cotton braids as the outer protection for outdoor distributing wires in the telephone plant has already resulted in a substantial reduction in the frequency of occurrence of troubles in this part of the plant. It is expected that such improvement will continue as a larger percentage of wires of the older type are replaced by the newer jacketed wires. The improvements in maintaining continuity of service which were anticipated in the early tests on these wires approximately 10 years ago are now well established and are resulting in considerably reduced maintenance effort. The resulting maintenance savings far exceed the slightly increased cost of the jacketed wire as compared to the braided wires.

★ ★ ★

Acknowledgment

THE author is indebted to several members of the Technical Staff of Bell Telephone Laboratories for assistance in preparing this article and in providing data used in the charts. The aid of Messrs. G. N. Vacca and W. S. Bishop was of particular value and is hereby acknowledged.

★ ★ ★

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Production and Application of Copper—Base Alloy Wire

(*Continued from page 839*)

the kind of wire in question. Most inspection is done at the finishing machine so that any faulty condition can be corrected immediately. In this way, the efforts of the inspectors are directed toward maintaining highest quality of the wire throughout each order.

★ ★ ★

The Possible End of the Cleaning House Seen

A NEW, and radically different, wire drawing compound has just been announced by **Harold Trembicki**, Manager of the Metal Coating Division of **Magnus Chemical Company**, Garwood, New Jersey, which may have quite an impact upon present wire drawing and coating practices.

★ ★ ★

THE new coating, which has been named "MAGICOAT" (Patent Pending), is designed for drawing wire without any acid cleaning. Very fine results have been obtained on annealed stainless steel rod and wire, patented high carbon rod and wire, and low carbon wire. Magicoat is not recommended for green hot rolled rod because of the variations in scale conditions, nor for one or two-hole bright wire.

★ ★ ★

TESTS have been made under 100% humidity conditions which have definitely proven that rod and wire coated with Magicoat are completely impervious to rust.

★ ★ ★

BECAUSE no acid is used, physical properties are extremely well controlled, which should be of particular interest to producers of rope wire, spring wire, and any other type of wire which requires carefully controlled physicals.

★ ★ ★

MAGICOAT is used in hot solution, and the only equipment necessary is a coating tank, or tanks. This should be especially interesting to those plants which have long wanted to coat their own wire, but were discouraged by the many problems involved in installing pickling tanks. They can now buy their rod or wire annealed or patented, dip it, and draw it.

★ ★ ★

THIS new coating is still more or less in the experimental stage, but rapid progress is being made, and the results obtained so far are very encouraging. It is anticipated that in the not-too-distant future, the Magicoat Method will eliminate the cleaning house as we now know it. The grim problem of acid disposal, the high maintenance costs in the cleaning house, loss of many thousands of pounds of valuable metal through acid cleaning, as well as the well-known pickling bottleneck, are among the problems which Mr. Trembicki hopes to solve with his new coating compound.

★ ★ ★

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Youngstown Welding & Eng'g Corp., The 802

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ABRASIVES—
Norton Co., Worcester, Mass.

ACID INHIBITORS—
(See Inhibitors, Pickling)

ACID-PROOF CONSTRUCTION—
Ceilcote Company, Cleveland, Ohio.
Chemsteel Construction Co., Pittsburgh, Pa.
Haveg Corporation, Newark, Del.
Nukem Products, Buffalo, N. Y.

ANNEALING MACHINES—Open Flame
Syncro Machine Co., Perth Amboy, N. J.

ANNEALING POTS AND BOXES—
Scudder, E. J., Foundry & Machine Co., Trenton, N. J.

ARMORING EQUIPMENT—
American Insulating Machy. Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc, Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Machy., Inc., Pawtucket, R. I.

BAKERS—Rod and Wire
Carl-Mayer Corp., The, Cleveland, Ohio.
Drying Systems, Inc., Chicago, Ill.
Morgan Construction Co., Worcester, Mass.
Ross, J. O., Engr. Corp., New York, N. Y.

BAR STOCK—Stainless Steel
American Steel & Wire Company, Cleveland, Chicago, New York.
Columbia Steel Co., San Francisco, Calif.
U. S. Steel Export Company, New York, N. Y.

BOBBINS—Braider & Wire Weaving
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

BORAX—Wire Drawing
Pacific Coast Borax Corp., New York, N. Y.

BORON CARBIDE—
Norton Co., Worcester, Mass.

BRAKES—Pneumatic
Entwistle, Jas. L. Co., Pawtucket, R. I.

CABLE—Aluminum
Aluminum Co. of America, Pittsburgh, Pa.

CABLE LACQUERING OVENS—
Industrial Ovens, Inc., Cleveland, O.

CARRIERS—Braider, High Speed
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New England Butt Co., Providence, R. I.
Williams, A. R., Machy. Co., Ltd., Toronto, Canada.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

CASTINGS—Wire Mill
Scudder, E. J., Fdry. & Mach. Co., Trenton, N.J.

CEMENTS—Acid Proof
Ceilcote Company, Cleveland, Ohio.

CEMENTS—Refractory
Norton Co., Worcester, Mass.

CERAMIC WEAR PART MATERIAL
Heany Industrial Ceramics Corp., New Haven, Conn.

CHEMICALS—Cleaning
(See Cleaners—Metal)

CLEANERS—Metal
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Phila., Pa.
Houghton, E. F., & Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Magnuson Products Corp., Brooklyn, N. Y.
Metal & Thermit Corp., New York, N. Y.
Oakite Products, Inc., New York, N. Y.
The Parkin Chemical Company, Pittsburgh, Pa.
Standard Industrial Compounds Co., Inc., Chicago, Ill.

CLEANING & PICKLING EQUIP.—
Ceilcote Company, Cleveland, Ohio.
Chemsteel Construction Co., Pittsburgh, Pa.
Cleveland Tramrail Div., of the Cleveland Crane & Engineering Co., Wickliffe, O.
Haveg Corp., Newark, Del.
Holden, A. F., Company, The, New Haven, Conn. and Detroit, Mich.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp., Cleveland, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

CLOTH—WIRE, All Metals
Roebling's, John A. Sons, Co., Trenton, N. J.
Wickwire Bros., Cortland, N. Y.

COATING COMPOUNDS—
Apex Alkali Products Co., Philadelphia, Pa.
Houghton, E. F. & Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Inc., Chicago, Ill.

COILERS—Sheet, Strip and Wire
Entwistle, Jas. L. Co., Pawtucket, R. I.
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J. Machine Co., Newark, N. J.
Torrington Mfg. Co., Torrington, Conn.
Wean Equipment Corp., Cleveland, Ohio.

COLD HEADERS—
Ajax Manufacturing Co., Cleveland, Ohio.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

COMPOUNDS—Coppering
American Chemical Paint Co., Ambler, Pa.

COMPOUNDS—Diamond
Eastern Carbide Corp., New Rochelle, N. Y.
Elgin National Watch Company, Elgin, Ill.
Hyprez Division, Engis Equipment Co., Chicago, Ill.
Magnus Chemical Co., Garwood, N. J.

COMPOUNDS—For Improving Drawing and Extrusion
American Chemical Paint Co., Ambler, Pa.

COMPOUNDS—Metal Finishing
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Metal & Thermit Corp., New York, N. Y.

COMPOUNDS—Phosphate Coating
American Chemical Paint Co., Ambler, Pa.

COMPOUNDS—Rust Preventing
American Chemical Paint Co., Ambler, Pa.
American Lanolin Corp., Lawrence, Mass.
Apex Alkali Products Co., Philadelphia, Pa.
Houghton, E. F. & Co., Philadelphia, Pa.
Magnus Chemical Co., Garwood, N. J.
Oakite Products, Inc., New York, N. Y.
Shell Oil Company, New York, N. Y.

COMPOUNDS—Rust Removing
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Houghton, E. F. & Co., Philadelphia, Pa.
Oakite Products, Inc., New York, N. Y.
Standard Industrial Compounds Co., Inc., Chicago, Ill.

COMPOUNDS—Wire Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Bick, Hans C., Inc., Reading, Pa.
Houghton, E. F. & Co., Philadelphia, Pa.
Ironsides Co., The, Columbus, Ohio.
Magnus Chemical Co., Garwood, N. J.
Magnuson Products Corp., Brooklyn, N. Y.
Miller, R. H. Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Pacific Coast Borax Corp., New York, N. Y.
Potter, Neil C., Newark, N. J.
Reilly-Whiteman-Walton Company, Conshohocken, Pa.
Shell Oil Company, New York, N. Y.
Standard Industrial Compounds Co., Inc., Chicago, Ill.
Swift & Company, Chicago, Ill.

CONDUCTORS—Flexible, Electrical
Montgomery Co., The, Windsor Locks, Conn.

COPHOLDERS—Steel
Apco Mossberg Co., Attleboro, Mass.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

CORDS—Electrical, Tinsel Conductor
Montgomery Co., The, Windsor Locks, Conn.

CORROSION PREVENTIVES—
Angier Corporation, The, Framingham, Mass.

CRANES—Wire Mill
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.
Morgan Construction Co., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

CUTTING TOOLS—Carbide
Carboloy Co., Inc., Detroit, Mich.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth-Sterling Steel & Carbide Corp., McKeesport, Pa.
Metal Carbides Corporation, Youngstown, Ohio.
Rusch Wire Die Corp., Croton-on-the-Hudson, New York.
Vascoloy-Ramet Corp., North Chicago, Ill.

CUTTING TOOLS—Wire
Porter, H. K., Inc., Everett, Mass.

DIAMONDS—Industrial
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Diamond Distributors, Inc., New York, N. Y.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIAMOND POWDERS—
Danforth, C. W., Co., Youngstown, Ohio.
Diamond Distributors, Inc., New York, N. Y.
Eastern Carbide Corp., New Rochelle, N. Y.
Elgin National Watch Company, Elgin, Ill.
Hyprez Division, Engis Equipment Co., Chicago, Ill.
Indiana Wire Die Co., Ft. Wayne, Ind.
National Research Company, St. Claire Shores, Mich.
New England Wire Die Co., Worcester, Mass.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Union Wire Die Company, Stamford, Conn.
Wayne Wire Die Co., Hillside, N. J.

DIAMOND POWDER RECLAIMING
Hyprez Division, Engis Equipment Co., Chicago, Ill.
National Research Company, St. Claire Shores, Mich.
Union Wire Die Company, Stamford, Conn.

DIAMOND TOOLS—
Carboloy Co., Inc., Detroit, Mich.
Indiana Wire Die Co., Ft. Wayne, Ind.
Metal Carbides Corporation, Youngstown, Ohio.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIES—Carbide
(See Dies—Tungsten Carbide)

DIES—Cold Heading
American Carbide Die Company, Union City, N. J.
Carboloy Co., Inc., Detroit, Mich.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth-Sterling Steel & Carbide Corp., McKeesport, Pa.
Indiana Wire Die Co., Ft. Wayne, Ind.
Metal Carbides Corporation, Youngstown, Ohio.
Vascoloy-Ramet Corp., No. Chicago, Ill.

DIES—Diamond
Ajax Industrial Supplies, Inc., Fort Wayne, Ind.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Boulin, Victor J., New York, N. Y.
Cochaud Wire Die Corp., New York, N. Y.
Ft. Wayne Wire Die, Inc., Fort Wayne, Ind.
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
New England Wire Die Co., Worcester, Mass.
North American Philips Co. Inc., New York, N. Y.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Union Wire Die Company, Stamford, Conn.
Wayne Wire Die Co., Hillside, N. J.

DIES—Extrusion
American Carbide Die Company, Union City, N. J.
Carboloy Co., Inc., Detroit, Mich.
Eastern Carbide Corp. New Rochelle, N. Y.
Firth Sterling Steel & Carbide Corp., McKeesport, Pa.
Hartley Tool & Die Co., Thomaston, Conn.
Metal Carbides Corporation, Youngstown, Ohio.
Murex, Ltd., Rainham, England

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Robertson, John, Co., Brooklyn, N. Y.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Wayne Wire Die Co., Hillside, N. J.

DIES—Eyelet
American Carbide Die Company, Union City, N. J.
Eastern Carbide Corp. New Rochelle, N. Y.
Hartley Tool & Die Co., Thomaston, Conn.
Kelly Wire Die Corp., New York, N. Y.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.

DIES—Pointing
Sjogren Tool and Machine Co., Auburn, Mass.

DIES—Repairs & Re-Cutting
American Carbide Die Company, Union City, N. J.
Ajax Industrial Supplies, Inc., Fort Wayne, Ind.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Boulin, Victor J., New York, N. Y.
Carboloy Co., Detroit, Mich.
Cochaud Wire Die Corp., New York, N. Y.
Eastern Carbide Corp. New Rochelle, N. Y.
Firth-Sterling Steel & Carbide Corp., McKeesport, Pa.
Ft. Wayne Wire Die, Inc., Fort Wayne, Ind.
Hartley Tool & Die Co., Thomaston, Conn.
Indiana Wire Die Co., Ft. Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corporation, Youngstown, Ohio.
New England Wire Die Co., Worcester, Mass.
North American Philips Co., Inc., New York, N. Y
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Wayne Wire Die Co., Hillside, N. J.

DIES—Special Shapes, Etc.
American Carbide Die Company, Union City, N. J.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth-Sterling Steel & Carbide Corp., McKeesport, Pa.
Hartley Tool & Die Co., Thomaston, Conn.
Indiana Wire Die Co., Ft. Wayne, Ind.
Murex, Ltd., Rainham, England
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.

DIES—Swaging
Murex, Ltd., Rainham, England
Sjogren Tool & Machine Co., Inc., Auburn, Mass.

DIES—Tantalum Carbide
American Carbide Die Company, Union City, N. J.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Eastern Carbide Corp. New Rochelle, N. Y.
Firth-Sterling Steel & Carbide Corp., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corporation, Youngstown, Ohio.
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.

DIES—Tube Drawing
American Carbide Die Company, Union City, N. J.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth-Sterling Steel & Carbide Corp., McKeesport, Pa.
Hartley Tool & Die Co., Thomaston, Conn.
Indiana Wire Die Co., Fort Wayne, Ind.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corp., Youngstown, O.
Murex, Ltd., Rainham, England
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Vascoloy-Ramet Corp., North Chicago, Ill.
Williams, A. R., Machy. Co., Ltd., Toronto, Canada.

DIES—Tungsten Carbide
American Carbide Die Company, Union City, N. J.
Balloffet-Vianney Wire Die Co., Inc., Guttenberg, N. J.
Carboloy Co., Inc., Detroit, Mich.
Eastern Carbide Corp., New Rochelle, N. Y.
Firth-Sterling Steel & Carbide Corp., McKeesport, Pa.
Hartley Tool & Die. Co., Thomaston, Conn.
Kelly Wire Die Corp., New York, N. Y.
Metal Carbides Corp., Youngstown, O.
Murex, Ltd., Rainham, England
Rusch Wire Die Corp., Croton-on-the-Hudson, N. Y.
Union Wire Die Company, Stamford, Conn.
Vascoloy-Ramet Corp., North Chicago, Ill.
Wayne Wire Die Co., Hillside, N. J.

DRAW BENCHES—
(See MACHINERY—Draw Benches)

DRUMS—Flange Steel
Hubbard Spool Company, Chicago, Ill.

DRUMS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.
Watson Machine Co., The, Paterson, N. J.

DRYING EQUIPMENT—
Carl-Mayer Corp., The, Cleveland, Ohio.
Drying Systems, Inc., Chicago, Ill.
Industrial Ovens, Inc., Cleveland, Ohio.
National Rubber Machinery Co., Akron, Ohio.
Rockwell, W. S., Co., Fairfield, Conn.
Ross, J. O., Engineering Corp., New York, N. Y.

ENGINEERS—Consulting
Metal Fatigue—Fatigue of Materials Laboratory, Princeton, N. J.
Spring Design—Carlson Co., The, New York, N. Y.
Wire Mill—Lewis, Kenneth B., Worcester, Mass.
Fisher, E. J. P., North Jackson, Ohio.

EQUIPMENT—Insulation Testing
Davis, R. L., Elec. Co., Wallingford, Conn.
Entwistle, James L., Co., Pawtucket, R. I.
Williams, A. R., Machy. Co., Ltd., Toronto, Canada.

EYELETS—Brass or Zinc
Platt Bros. & Co., The, Waterbury, Conn.

FENCING & FENCES—Wire
Interlocking Fence Co., Morton, Ill.

FLUXES—Soldering
American Chemical Paint Co., Ambler, Pa.

FOAM PRODUCING COMPOUNDS—
American Chemical Paint Co., Ambler, Pa.
Parkin Chemical Company, The, Pittsburgh, Pa.

FRICTION PAY-OFF STANDS—
Industrial Ovens, Inc., Cleveland, Ohio.

FURNACES—Annealing
Ajax Electric Co., Inc., Philadelphia, Pa.
Carl-Mayer Corp., The, Cleveland, Ohio.
Drying Systems, Inc., Chicago, Ill.
Electric Furnace Co., Salem, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N. Y.
Holden, A. F., Co., The, New Haven, Conn. and Detroit, Mich.
Kenworthy, Charles F., Inc., Waterbury, Conn.
Loftus Engineering Company, Pittsburgh, Pa.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engr. Co., Cleveland, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Automatic
Electric Furnace Co., Salem, Ohio.
Kenworthy, Charles F., Inc., Waterbury, Conn.
Loftus Engineering Company, Pittsburgh, Pa.
Surface Combustion Corp., Toledo, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Brazing
Electric Furnace Co., Salem, Ohio.
Rockwell, W. S., Co., Fairfield, Conn.

FURNACES—Bright Annealing
Electric Furnace Co., Salem, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N. Y.
Michigan Oven Co., Detroit, Mich.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Electric
Electric Furnace Co., Salem, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N. Y.
Rockwell, W. S., Co., Fairfield, Conn.
Trauwood Engineering Co., The, Cleveland, Ohio.

FURNACES—Galvanizing Equipment
Ajax Electric Co., Inc., Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio.
Holden, A. F., Co., The, New Haven, Conn, and Detroit, Mich.
Rockwell, W. S. Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engineering Co., The, Cleveland, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

FURNACES—Hard'ing & Temp'ing
Ajax Electric Co., Inc., Philadelphia, Pa.
Drying Systems, Inc., Chicago, Ill.
Electric Furnace Co., Salem, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N. Y.
Holden, A. F., Co., The, New Haven, Conn, and Detroit, Mich.
Kenworthy, Charles F., Inc., Waterbury, Conn.
Loftus Engineering Company, Pittsburgh, Pa.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engineering Co., The, Cleveland, Ohio

FURNACES—Lead Melting
Electric Furnace Co., Salem, Ohio.
Robertson, John, Co., Brooklyn, N. Y.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Non-Oxidizing
Ajax Electric Co., Inc., Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio.
Holden, A. F., Co., The, New Haven, Conn, and Detroit, Mich.
Kenworthy, Charles F., Inc., Waterbury, Conn.
Loftus Engineering Company, Pittsburgh, Pa.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Normalizing
Ajax Electric Co., Inc., Philadelphia, Pa.
Carl-Mayer Corp., The, Cleveland, Ohio.
Drying Systems, Inc., Chicago, Ill.
Electric Furnace Co., Salem, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N. Y.
Holden, A. F., Co., The, New Haven, Conn, and Detroit, Mich.
Kenworthy, Charles F., Inc., Waterbury, Conn.
Loftus Engineering Company, Pittsburgh, Pa.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Pot (oil, gas, electric)
Ajax Electric Co., Inc., Philadelphia, Pa.
Holden, A. F., Co., The, New Haven, Conn, and Detroit, Mich.

FURNACES—Resistance Heating, Strand
Trauwood Engineering Co., The, Cleveland, Ohio.

FURNACES—Salt Bath
Ajax Electric Co., Inc., Philadelphia, Pa.
Electric Furnace Co., Salem, Ohio.
Holden, A. F., Co., The, New Haven, Conn, and Detroit, Mich.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.

FURNACES—Wire, Strip & Sheet
Carl-Mayer Corp., The, Cleveland, Ohio.
Eisler Engineering Co., Newark, N. J.
Electric Furnace Co., Salem, Ohio.
Harper Electric Furnace Corp., Niagara Falls, N. Y.
Kenworthy, Charles F., Inc., Waterbury, Conn.
Loftus Engineering Company, Pittsburgh, Pa.
Michigan Oven Co., Detroit, Mich.
Rockwell, W. S., Co., Fairfield, Conn.
Surface Combustion Corp., Toledo, Ohio.
Trauwood Engineering Co., The, Cleveland, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

GALVANIZING EQUIPMENT—
Steel Equipment Co., Cleveland, Ohio.
Wean Equipment Corp., Cleveland, Ohio.

GRINDERS—Roll
Norton Co., The, Worcester, Mass.

HAMMERS—Swaging
Sjogren Tool and Machine Co., Auburn, Mass.

HEAT EXCHANGERS
Nukem Products, Buffalo, N. Y.

HOOKS—Pickling & Liming
Bronze Die Casting Co., Pittsburgh, Pa.
Lewis Welding & Eng'g Corp., Bedford, Ohio.
Youngstown Welding & Engineering Co., Youngstown, Ohio.

HOISTS—Electric Travelling
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, Ohio.

WHERE TO BUY, Continued

INHIBITORS—Pickling
American Chemical Paint Co., Ambler, Pa.
Apex Alkali Products Co., Philadelphia, Pa.
Houghton, E. F. & Co., Philadelphia, Pa.
Oakite Products, Inc., New York, N. Y.
Parkin Chemical Company, The, Pittsburgh, Pa.

INSULATING LACQUERING SYSTEMS—Continuous
American Insulating Machine Co., Phila., Pa.
Industrial Ovens, Inc., Cleveland, Ohio.

INSULATING MATERIALS—
Belding, Heminway, Corticelli Co., New York, N. Y.
Du Pont de Nemours, E. J., Co., Wilmington, Del.
Glass Fibers, Inc., Waterville, Ohio.
Merrimac Paper Co., New York, N. Y.
New England Lacquer Co., E. Providence, R. I.
Owens Corning Fiberglas Corp., Toledo, O.
Standard Varnish Works, Staten Island, N. Y.
Twitchell, E. W., Philadelphia, Pa.

INSULATING MATERIALS—Paper — For Electric Wire Cable.
Merrimac Paper Co., New York, N. Y.
Twitchell, E. W., Philadelphia, Pa.

LACQUERS—For Electric Wire
New England Lacquer Co., E. Providence, R. I.
Standard Varnish Works, Staten Island, N. Y.

LAME—LAHN—
Montgomery Co., The, Windsor Locks, Conn.

LATHES—Die Reaming
Carboloy Co., Inc., Detroit, Mich.
Roos, Tool & Mfg. Co., Montclair, N. J.

LIME—
Warner Co., Philadelphia and Bellefonte, Pa.

LININGS—Acid and Alkali Proof
Haveg Corp., Newark, Del.

LUBRICANTS — For Metal Cutting, Stamping and Drawing
Apex Alkali Products Co., Philadelphia, Pa.
Houghton, E. F. & Co., Philadelphia, Pa.
Ironsides Co., The, Columbus, Ohio.
Magnus Chemical Co., Garwood, N. J.
Miller, R. H., Co., Inc., Homer, N. Y.
Oakite Products, Inc., New York, N. Y.
Reilly-Whiteman-Walton Company, Conshohocken, Pa.
Shell Oil Company, New York, N. Y.
Standard Industrial Compounds Co., Inc., Chicago, Ill.

LUBRICANTS—Wire Drawing
(See Compounds—Wire Drawing)

LUBRICANTS—Wire Rope
Swift & Co., Chicago, Ill.

LUMBER—Wire Mill, for lagging and car blocking
North Anson Reel Co., North Anson, Maine.

MACHINERY—Armoring (Cable, Wire Hose)
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Barbed Wire
Glader Machine Works, Chicago, Ill.
Wean Engineering Co., Cleveland, Ohio.

MACHINERY—Bead Wrapping
Terkelsen Machine Co., Boston, Mass.

MACHINERY—Braiding
Mossberg Pressed Steel Corp., Attleboro, Mass.
New England Butt Co., Providence, R. I.
Wardwell Braiding Machine Co., Central Falls, R. I.
Wire & Textile Mach'y, Inc., Pawtucket, R. I.

MACHINERY—Brazing
Eisler Engineering Co., Newark, N. J.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Bunching
American Insulating Mach'y Co., Phila., Pa.
Haskell-Dawes Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Bundling, Scrap
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Cable, Electric
American Insulating Mach'y Co., Phila., Pa.
Haskell-Dawes Machine Co., Philadelphia, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Chain Making
Nilson, A. H. Machine Co., The, Bridgeport, Conn.

MACHINERY—Cable, Rope Closing
New England Butt Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Coilers
Boyd & Sons Manufacturing Co., Phila., Pa.
Eisler Engineering Co., Newark, N. J.
Entwistle, Jas. L. Co., Pawtucket, R. I.
Morgan Construction Co., Worcester, Mass.
National Machinery Exchange (used), New York, N. Y.
New England Butt Co., Providence, R. I.
Ruesch, H. J. Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.
Watson Machine Co., Paterson, N. J.
Wean Equipment Corp., Cleveland, Ohio.
Williams, A. R., Machy. Co., Ltd., Toronto, Canada.
Wire & Textile Machinery, Inc., Pawtucket, R. I.

MACHINERY—Cold Heading
(See Cold Headers)

MACHINERY—Copper Wire Drawing and Rolling
Aetna-Standard Engineering Co., Youngstown, Ohio.
American Insulating Mach'y Co., Phila., Pa.
National Mach'y Exch. (Used), New York, N. Y.
Ruesch, H. J. Machine Co., Newark, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Fdry. & Mach. Co., Waterbury, Conn.

MACHINERY—Covering Wire
American Insulating Mach'y Co., Phila., Pa.
National Erie Corp., Erie, Pa.
National Rubber Machinery Co., Akron, Ohio.
New England Butt Co., Providence, R. I.
Royle, John & Sons, Paterson, N. J.
Standard Machinery Co., Mystic, Conn.
Syncro Machine Co., Perth Amboy, N. J.
Wardwell Braiding Machine Co., Central Falls, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Cutting
Eisler Engineering Co., Newark, N. J.
Lewis Machine Co., The, Cleveland, Ohio.
Mettler Machine Tool, Inc., New Haven, Conn.
National Mach'y Exch. (Used) New York, N. Y.
Nilson Machine Co., A. H., Bridgeport, Conn.
Porter, H. K., Inc., Everett, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Die Making
Carboloy Co., Inc., Detroit, Mich.
Crossley, George, Ltd., Cleckheaton, England.
Firth-Sterling Steel & Carbide Corp., McKeesport, Pa.
Kelly Wire Die Corp., New York, N. Y.
Red Star Engineering, Inc., Rahway, N. J.
Roos, Tool & Mfg. Co., Montclair, N. J.
Union Wire Die Company, Stamford, Conn.
Wayne Wire Die Co., Hillside, N. J.

MACHINERY—Draw Benches
Aetna-Standard Engineering Co., Youngstown, Ohio.
Ajax Manufacturing Co., Cleveland, Ohio.
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J., Machine Co., Newark, N. J.
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Edging
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Enameling
American Insulating Mach'y Co., Phila., Pa.
Industrial Ovens, Inc., Cleveland, Ohio.
Michigan Oven Co., Detroit, Mich.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Extruding
Modern Plastic Machy. Corp., Lodi, N. J.
National Erie Company, Erie, Pa.
National Rubber Machinery Co., Akron, Ohio.
Robertson, John, Co., Brooklyn, N. Y.
Royle, John, & Sons, Paterson, N. J.
Standard Machinery Co., Mystic, Conn.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Fence
Glader, Wm., Machine Works, Chicago, Ill.
Interlocking Fence Co,, Morton, Ill.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Filament Coil Winding
Eisler Engineering Co., Newark, N. J.

MACHINERY—Flat Wire
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Galvanizing
(See Galvanizing Equipment)

MACHINERY—Galvanizing Wire
Sleeper & Hartley, Inc., Worcester, Mass.
Steel Equipment Co., Cleveland, Ohio.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp., Cleveland, Ohio.
Wilson, Lee, Engr. Co., Cleveland, Ohio.

MACHINERY—Gang Winders
Entwistle, Jas. L. Co., Pawtucket, R. I.
Ruesch, H. J., Machine Co., Newark, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Grinding
Norton Co., The, Worcester, Mass.

MACHINERY—Insulating
American Insulating Mach'y Co., Phila., Pa.
Modern Plastic Machy. Corp., Lodi, N. J.
National Erie Company, Erie, Pa.
National Rubber Machinery Co., Akron, Ohio.
New England Butt Co., Providence, R. I.
Royle, John & Sons, Paterson, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Lead Encasing Presses, etc.
Robertson, John Co., Brooklyn, N. Y.

MACHINERY—Lead Stripping
Robertson, John Co., Brooklyn, N. Y.

MACHINERY—Lock Washer
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Looms, Wire Weaving
Fitz Water Wheel Company, Hanover, Pa.
Interlocking Fence Co., Morton, Ill.

MACHINERY—Magnet Wire
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Material Handling
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

MACHINERY—Measuring Wire & Cable
Durant Mfg. Co., Milwaukee, Wis.
Entwistle, Jas. L. Co., Pawtucket, R. I.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Nail and Tack
Glader, Wm., Machine Works, Chicago, Ill.
National Mach'y Exch. (Used), New York, N.Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Wean Equipment Corp., Cleveland, Ohio.

WHERE TO BUY, Continued

MACHINERY—Panning
American Insulating Mach'y Co., Phila., Pa.
Syncro Machine Co., Perth Amboy, N. J.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Pickling
Chemsteel Construction Co., Pittsburgh, Pa.
Youngstown Welding & Engineering Co., Youngstown, Ohio.

MACHINERY—Pointing
Aetna-Standard Engineering Co., Youngstown, Ohio.
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York, N.Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry & Mach. Co., Trenton, N.J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Poultry Wire Fencing
Interlocking Fence Co., Morton, Ill.

MACHINERY—Rod Mill
Morgan Construction Co., Worcester, Mass.
Ruesch, H. J., Machine Co., Newark, N. J.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Rolling Mill
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York, N.Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Rubber Insulating
National Rubber Machinery Co., Akron, Ohio.
Royle, John & Sons, Paterson, N. J.
Standard Machinery Co., Mystic, Conn.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Rubber Tubing and Straining
National Rubber Machinery Co., Akron, Ohio.
New England Butt Co., Providence, R. I.
Royle, John & Sons, Paterson, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Mystic, Conn.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Screw Wire
National Mach'y Exch. (Used), New York, N.Y.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Special
American Insulating Mach'y Co., Phila., Pa.
Davis, R. L. Electric Co., Wallingford, Conn.
Emory, Robert J., Co., Newark, N. J.
Entwistle, Jas. L. Co., Pawtucket, R. I.
New England Butt Co., Providence, R. I.
Red Star Engineering, Inc., Rahway, N. J.
Ruesch, H. J. Machine Co., Newark, N. J.
Scudder, E. J., Fdry & Mach. Co., Trenton, N.J.
Sjogren Tool and Machine Co., Auburn, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Machinery Co., Mystic, Conn.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Spooling
American Insulating Mach'y Co., Phila., Pa.
Boyd & Sons Manufacturing Co., Phila., Pa.
Davis, R. L. Electric Co., Wallingford, Conn.
Eisler Engineering Co., Newark, N. J.
Emory, Robert J., Co., Newark, N. J.
Entwistle, Jas. L. Co., Pawtucket, R. I.
National Mach'y Exch. (Used), New York, N.Y.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Steel Equipment Co., Cleveland, Ohio.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Watson Machine Co., Paterson, N. J.
Wean Equipment Corp., Cleveland, Ohio.
Wire & Textile Mach'y, Inc., Pawtucket, R. I.

MACHINERY—Spring Making
Lundahl Corp., Hartford, Conn.
National Mach'y Exch. (Used), New York, N.Y.
Sleeper & Hartley, Inc., Worcester, Mass.
Torrington Mfg. Co., Torrington, Conn.
Wells, Frank L., Co., Kenosha, Wisc.

MACHINERY—Staple
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Straightening
Ajax Manufacturing Co., Cleveland, Ohio.
Lewis Machine Co., The, Cleveland, Ohio.
Mettler Machine Tool Co., New Haven, Conn.
National Mach'y Exch. (Used), New York, N.Y.
Nilson, A. H. Machine Co., Bridgeport, Conn.
Norsholm Industries, Rochester, Michigan.
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Wean Equipment Corp., Cleveland, Ohio.
Wells, Frank L., Co., Kenosha, Wisc.

MACHINERY—Stranding
Haskell-Dawes Machine Co., Philadelphia, Pa.
Hughesville Machine & Tool Co., Hughesville, Pa.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Providence, R. I.
Watson Machine Co., Paterson, N. J.

MACHINERY—Strip Steel
Aetna-Standard Engineering Co., Youngstown, Ohio.
Ruesch, H. J., Machine Co., Newark, N. J.
Steel Equipment Co., Cleveland, Ohio.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Swaging
National Mach'y Exch. (Used), New York, N.Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.

MACHINERY—Taping
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Testing Physical
Lundahl Corporation, Hartford, Conn.
Scott Testers, Inc., Providence, R. I.

MACHINERY—Testing Equipment—Sparkers
Davis, R. L. Elec. Co., Wallingford, Conn.
Entwistle, Jas. L., Pawtucket, R. I.
Wire & Textile Machinery, Inc., Pawtucket, R.I.

MACHINERY—Tinning Wire
American Insulating Mach'y Co., Phila., Pa.
New England Butt Co., Providence, R. I.
Steel Equipment Co., Cleveland, Ohio.
Syncro Machine Co., Perth Amboy, N. J.
Wean Equipment Co., Cleveland, Ohio.

MACHINERY—Tinsel Rolling Mills
American Insulating Mach'y Co., Phila., Pa.
Syncro Machine Co., Perth Amboy, N. J.
Torrington Mfg. Co., Torrington, Conn.

MACHINERY—Trolley Wire
Torrington Mfg. Co., Torrington, Conn.
Vaughn Machinery Co., Cuyahoga Falls, O.

MACHINERY—Tube Mill
Marshall-Richards Machine Company, Ltd., Trenton, N. J.

MACHINERY—Twinning
(See Mach.—Bunching)

MACHINERY—Welding Wire
Eisler Engineering Co., Newark, N. J.
Micro Products Co., Chicago, Ill.
Syncro Machine Co., Perth Amboy, N. J.

MACHINERY—Winding
American Insulating Mach'y Co., Phila., Pa.
Davis, R. L. Electric Co., Wallingford, Conn.
Eisler Engineering Co., Newark, N. J.
New England Butt Co., Providence, R. I.
Sleeper & Hartley, Inc., Worcester, Mass.
Standard Mill Supply, Pawtucket, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Winding Wire
Standard Mill Supply, Pawtucket, R. I.

MACHINERY—Wind-up (Constant Tension, Variable Speed)
Aetna-Standard Engineering Co., Youngstown, Ohio.
Davis, R. L. Electric Co., Wallingford, Conn.
Industrial Ovens, Inc., Cleveland, Ohio.
Marshall-Richards Machine Company, Ltd., Trenton, N. J.
National Rubber Mach'y Co., Akron, Ohio.
Standard Machinery Co., Mystic, Conn.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wire Bending
Eisler Engineering Co., Newark, N. J.
Kilmer, M. D., & Co., Cleveland, Ohio.

MACHINERY—Wire Drawing
Aetna-Standard Engineering Co., Youngstown, Ohio.
Ajax Manufacturing Company, Cleveland, Ohio.
American Insulating Mach'y Co., Phila., Pa.
Marshall-Richards Machine Company, Ltd., Trenton, N. J.
Morgan Construction Co., Worcester, Mass.
National Mach'y Exch. (Used), New York, N.Y.
Ruesch, H. J., Machine Co., Newark, N. J.
Scudder, E. J., Fdry & Mach. Co., Trenton, N.J.
Sleeper & Hartley, Inc., Worcester, Mass.
Steel Equipment Co., Cleveland, Ohio.
Syncro Machine Co., Perth Amboy, N. J.
Vaughn Machinery Co., Cuyahoga Falls, O.
Waterbury-Farrel Foundry & Machine Co., Waterbury, Conn.
Wean Equipment Corp., Cleveland, Ohio.

MACHINERY—Wire Forming
Kilmer, M. D. & Co., Cleveland, Ohio.
National Mach'y Exch. (Used), New York, N.Y
Nilson Machine Co., A. H., Bridgeport, Conn.
Sleeper & Hartley, Inc., Worcester, Mass.

MACHINERY—Wire Rope
New England Butt Co., Providence, R. I.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

MACHINERY—Wood Screw
National Mach'y Exch. (Used), New York, N.Y.

MACHINERY—Wrapping Straight Lengths and Tubing
Angier Corporation, The, Framingham, Mass.
Terkelsen Machine Co., Boston, Mass.

MACHINERY—Wrapping Wire Coils
Angier Corporation, The, Framingham, Mass.
Terkelsen Machine Co., Boston, Mass.

MATERIAL HANDLING EQUIPMENT
Cleveland Tramrail Div. of The Cleveland Crane & Engineering Co., Wickliffe, O.

MILLS—Tandem, Rolling & Edging
Torrington Mfg. Co., Torrington, Conn.
Wean Equipment Co., Cleveland, Ohio.

NAILS—Wire
American Steel & Wire Co., Cleveland, Chicago, New York.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Steel Co., San Francisco, Calif.
Continental Steel Corp., Kokomo, Ind.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling, John A. Sons Co., Trenton, N. J.
U. S. Steel Export Co., New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.

OVENS—Cable Lacquering
American Insulating Mach'y Co., Phila., Pa.
Carl-Mayer Corp., The, Cleveland, Ohio.
Industrial Ovens, Inc., Cleveland, Ohio.
Michigan Oven Co., Detroit, Mich.

WHERE TO BUY, Continued

OVENS—Dehydrogenizing
Industrial Ovens, Inc., Cleveland, Ohio.

OVENS—Industrial
Drying Systems, Inc., Chicago, Ill.
Industrial Ovens, Inc., Cleveland, Ohio.
Michigan Oven Co., Detroit, Mich.
Ross, J. O., Engr. Corp., New York, N. Y.

OVENS—Rod Bakers
Carl-Mayer Corp., The, Cleveland, Ohio.
Drying Systems, Inc., Chicago, Ill.
Michigan Oven Co., Detroit, Mich.
Rockwell, W. S. Co., Fairfield, Conn.
Ross, J. O. Eng'g Corp., N. Y., N. Y.

OVENS—Welding Rod Coating
Carl-Mayer Corp., The, Cleveland, Ohio.
Drying Systems, Inc., Chicago, Ill.
Industrial Ovens, Inc., Cleveland, Ohio.
Ross, J. O., Engr. Corp., New York, N. Y.

PAINT—Acid Proof
Ceilcote Company, Cleveland, Ohio.

PAINT BONDING CHEMICALS—
American Chemical Paint Co., Ambler, Pa.

PAINTS—Heat Resisting
American Chemical Paint Co., Ambler, Pa.

PANS—Vulcanizing
Mossberg Pressed Steel Corp., Attleboro, Mass.

PAPER—Creped Wrapping
Angier Corporation, The, Framingham, Mass.
Crepe-Kraft Company, The, Division National Waterproof Papers, Inc., Newark, N. J.
Terkelsen Machine Co., Boston, Mass.

PAPER—For Coil Wrapping and Corrosion Prevention
Angier Corporation, The, Framingham, Mass.
Crepe-Kraft Company, The, Division National Waterproof Papers, Inc., Newark, N. J.
Terkelsen Machine Co., Boston, Mass.

PATENT ATTORNEYS—
Lancaster, Allwine & Rommel, Washington, D.C.

PHOSPHATE COATING CHEMICALS
American Chemical Paint Co., Ambler, Pa.
Oakite Products, Inc., New York, N. Y.

PICKLING COMPOUNDS—
See (Inhibitors—Pickling)

PICKLING—Hooks, etc. Acid Resisting
Bronze Die Casting Co., Pittsburgh, Pa.
Lewis Welding & Eng'g Corp., Bedford, Ohio.
Nukem Products, Buffalo, N. Y.
Youngstown Welding & Engineering Co., Youngstown, Ohio.

PICKLING TANK LININGS—
Chemsteel Construction Co., Pittsburgh, Pa.
Haveg Corp., Newark, Del.

PIPES & FITTINGS—Acid Resistant
Haveg Corp., Newark, Del.
Knight Maurice Co., Akron, Ohio.

PLASTIC TESTERS—
Scott Testers, Inc., Providence, R. I.

PLATING PROCESS—Electrolytic
Kenmore Metals Corp., Jersey City, N. J.

PNEUMATIC CYLINDERS—
Entwistle, James L. Co., Pawtucket, R. I.

POTS—Lacquer
Industrial Ovens, Inc., Cleveland, Ohio.

POTS—Lead Melting
Robertson, John, Co., Brooklyn, N. Y.

PRESSES—Hydraulic and Mechanical
Robertson, John, Co., Brooklyn, N. Y.
Standard Machinery Co., Mystic, Conn.

PRESSES—Lead
Robertson, John, Co., Brooklyn, N. Y.

PULLERS AND GRIPS—For Wire
Morgan Construction Co., Worcester, Mass.
Scudder, E. J. Fdry & Mach. Co., Trenton, N.J.
Sjogren Tool and Machine Co., Auburn, Mass.
Sleeper & Hartley, Inc., Worcester, Mass.
Vaughn Machinery Co., Cuyahoga Falls, O.
Wean Equipment Corp., Cleveland, Ohio.

PUMPS—for Corrosive Liquids
Nukem Products, Buffalo, N. Y.

PUMPS—Hydraulic
Robertson, John, Co., Brooklyn, N. Y.

REEL AND TENSION STANDS—
Davis, R. L. Electric Co., Wallingford, Conn.
Entwistle, James L., Co., Pawtucket, R. I.
Industrial Ovens, Inc., Cleveland, Ohio.
Roll-a-Reel, Cincinnati, Ohio.
Sleeper & Hartley, Inc., Worcester, Mass.
Syncro Machine Co., Perth Amboy, N. J.
Watson Machine Co., Paterson, N. J.

REEL CRUTCHES—
Roll-a-Reel, Cincinnati, Ohio
Watson Machine Co., Paterson, N. J.

REELS & SPOOLS—Drawn Aluminum Alloy
Acrometal Products, Inc., Minneapolis, Minn.
Hubbard Spool Co., Chicago, Ill.

REELS & SPOOLS—Annealing and Stranding
Acrometal Products, Inc., Minneapolis, Minn.
American Pulley Company, Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Co., Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp. Niles, Ohio.

REELS & SPOOLS—Collapsible
Entwistle, Jas. L. Co., Pawtucket, R. I.

REELS & SPOOLS—Plastic
Hubbard Spool Co., Chicago, Ill.

REELS & SPOOLS—Steel
American Pulley Company, Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Clark, J. L., Mfg. Co., Rockford, Ill.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Co., Chicago, Ill.
Mason Can Company, Providence, R. I.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS AND SPOOLS—Shipping and Shop
Acrometal Products, Inc., Minneapolis, Minn.
American Pulley Company, Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg. Co., The, Hazardville, Conn.
Clark, J. L., Mfg., Co., Rockford, Ill.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Co., Chicago, Ill.
Mason Can Company, Providence, R. I.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.
North Anson Reel Co., North Anson, Maine.

REELS & SPOOLS—Wooden
Acrometal Products, Inc., Minneapolis, Minn.
American Woodworking Co., Chicago, Ill.
Bridge Mfg. Co., Inc., The, Hazardville, Conn.
Durkee Mfg. Co., Pine River, Minn.
Nelson Co., The, Baltimore, Md.
North Anson Reel Co., North Anson, Maine.
North Waterford Spool Co., No. Waterford, Me.

REELS—Metal Bound
Durkee Mfg. Co., Pine River, Minn.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Co., Chicago, Ill.
North Anson Reel Co., North Anson, Maine.

REELS—Takeoff
Acrometal Products, Inc., Minneapolis, Minn.
American Pulley Company, Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg. Co., The, Hazardville, Conn.
Clark, J. L. Mfg. Co., Rockford, Ill.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.
North Anson Reel Co., North Anson, Maine.

REELS—Vulcanizing & Impregnating
Apco Mossberg Co., Attleboro, Mass.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS—Wire Drawing
Acrometal Products, Inc., Minneapolis, Minn.
American Pulley Company, Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

REELS—Wire Mill
Acrometal Products, Inc., Minneapolis, Minn.
American Pulley Company, Philadelphia, Pa.
Apco Mossberg Co., Attleboro, Mass.
Bridge Mfg., Co., The, Hazardville, Conn.
Durkee Mfg. Co., Pine River, Minn.
Howsam Spool Co., Aurora, Ill.
Hubbard Spool Company, Chicago, Ill.
Mason Can Company, Providence, R. I.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.
North Anson Reel Co., North Anson, Maine.

REFRACTORIES—High Temperature
Norton Company, Worcester, Mass.

RESISTANCE HEATING—Annealing Patenting, Etc.
Trauwood Engr. Co., Cleveland, Ohio.

ROD BAKERS—
(See Ovens—Rod Bakers)

RODS—Aluminum
Aluminum Co. of America, Pittsburgh, Pa.
Kaiser Aluminum & Chemical Sales, Inc., Oakland, California.

RODS—Nickel Alloy
International Nickel Co., Inc., New York, N.Y.

RODS—Stainless Steel
American Steel & Wire Co., Cleveland, Ohio.

RODS—Steel, Electrolytically Coated
Kenmore Metals Corp., Jersey City, N. J.

RODS—Wire—Non-Ferrous
American Brass Co., The, Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.
Platt Bros. & Co., The, Waterbury, Conn.

RODS—Wire, Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Indiana.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling's John A., Sons Co., Trenton, N. J.
Youngstown Sheet & Tube Co., Youngstown, O.

ROPE—Wire
American Steel & Wire Company, Cleveland, Chicago, New York.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Steel Co., San Francisco, Calif.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Roebling's John A., Sons Co., Trenton, N. J.
U. S. Steel Export Co., New York, N. Y.

RUBBER AND RUBBER COMPRESSION TESTERS—
Scott Testers, Inc., Providence, R. I.

RUST PROOF COMPOUNDS—
(See Compounds—Rust Preventing)

RUST REMOVING COMPOUNDS—
(See Compounds—Rust Preventing)

SALTS—Heat Treating, Descaling, etc.
Holden, A. F., Company, The, New Haven, Conn. and Detroit, Mich.
Houghton, E. F. & Co., Philadelphia, Pa.

WHERE TO BUY, Continued

SATURATION SYSTEMS—
Industrial Ovens, Inc., Cleveland, Ohio.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y Inc., Pawtucket, R. I.

SOAPS—Industrial and Wire Drawing
(See Compounds—Wire Drawing)

SOLVENT RESIN SYSTEMS—Experimental
Industrial Ovens, Inc., Cleveland, Ohio.

SPOOLS—Wood, for Retail Wire Sales
North Waterford Spool Co., No. Waterford, Me.

STAMPINGS—Steel
Hubbard Spool Company, Chicago, Ill.
Mossberg Pressed Steel Corp., Attleboro, Mass.

STRIP—Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Laclede Steel Company, St. Louis, Mo.
Roebling's, John A., Sons Co., Trenton, N. J.
Seneca Wire & Mfg. Co., Fostoria, Ohio.
Youngstown Sheet & Tube Co., Youngstown, O.

SWIFTS—Take-off
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
Watson Machine Co., Paterson, N. J.

TANKS—Compound
Haveg Corp., Newark, Del.
Watson Machine Co., Paterson, N. J.

TANKS—Pickling
Ceilcote Company, Cleveland, Ohio.
Chemsteel Construction Co., Pittsburgh, Pa.
Haveg Corp., Newark, Del.
Knight, Maurice Co., Akron, Ohio.

TANKS—Steel
Chemsteel Construction Co., Pittsburgh, Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.

TINSEL—Cords, Decorative
(See: Tinsel—Electric Conductor)

TINSEL—Electric Conductor
Hudson Wire Co., Ossining, N. Y.
Montgomery Co., The, Windsor Locks, Conn.

TINSEL—Electric Resistance
(See: Tinsel—Electric Conductor)

TINSEL—Lame, Silver and False Gold
(See: Tinsel—Electric Conductor)

TINSEL—Thread, Silver and False Gold
(See: Tinsel—Electric Conductor)

TINSEL—Thread, Decorative
(See: Tinsel—Electric Conductor)

TINSEL—Wire
(See: Tinsel—Electric Conductor)

TOOLS—Spring Forming
Lundahl Corporation, Hartford, Conn.

TOOLS—Wire Cutting
Porter, H. K., Inc., Everett, Mass.

TRAMRAIL SYSTEMS—
Cleveland Tramrail Div. of the Cleveland Crane & Engineering Co., Wickliffe, O.

TRAVERSES—For Reels
Entwistle, James L. Co., Pawtucket, R. I.
Hubbard Spool Company, Chicago, Ill.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.

TRAVERSE MECHANISMS—
Apco Mossberg Co., Attleboro, Mass.
Mossberg Pressed Steel Corp., Attleboro, Mass.
New England Butt Co., Providence, R. I.
Niles Steel Products Div., Republic Steel Corp., Niles, Ohio.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y Inc., Pawtucket, R. I.

TUBE BENDERS AND FORMERS—
H. D. Kilmer Co., Cleveland, Ohio.
Ruesch, H. J., Machine Co., Newark, N. J.

VALVES & FITTINGS—Acid Resistant
Haveg Corp., Newark, Del.

VARNISHES—For Insulation
Standard Varnish Works, Staten Island, N. Y.

VULCANIZERS—
Watson Machine Co., Paterson, N. J.

VULCANIZING PANS—
American Insulating Mach'y Co., Phila., Pa.
Mossberg Pressed Steel Corp., Attleboro, Mass.

WELDERS—Spot and Butt
Eisler Engineering Co., Newark, N. J.
Micro Products Co., Chicago, Ill.

WIND-UP AND UNWIND SYSTEMS—Continuous
American Insulating Mach'y Co., Phila., Pa.
Davis R. L. Electric Co., Wallingford, Conn.
Entwistle, James L., Co., Pawtucket, R. I.
Industrial Ovens, Inc., Cleveland, Ohio.
Watson Machine Co., Paterson, N. J.
Wire & Textile Mach'y, Inc., Pawtucket, R. I.

WIRE—Aluminum
Aluminum Co. of America, Pittsburgh, Pa.
Elmet Division, North American Philips Company, Inc., Lewistown, Maine.
Kaiser Aluminum & Chemical Sales, Inc., Oakland, California.
Malin & Co., Cleveland, Ohio.

WIRE—Barbed
Interlocking Fence Co., Morton, Ill.

WIRE—Bookbinding
Laclede Steel Company, St. Louis, Mo.

WIRE—Cast
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Cold Heading
American Steel & Wire Co., Cleveland-Chicago, New York.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Steel Co., San Francisco, Calif.
Continental Steel Corp., Kokomo, Ind.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Laclede Steel Company, St. Louis, Mo.
Roebling's, John A., Sons Co., Trenton, N. J.
U. S. Steel Export Co., New York, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Electric
American Brass Company, The, Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.
Malin & Co., Cleveland, Ohio.

WIRE—Enameled for Coils
Winsted Division of Hudson Wire Co., Winsted, Conn.

WIRE—Flat, Fine
Elmet Division, North American Philips Company, Inc., Lewistown, Maine.
Montgomery Co., The, Windsor Locks, Conn.

WIRE—Manufacturers
American Steel & Wire Co., Cleveland-Chicago, New York.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Steel Co., San Francisco, Calif.
Continental Steel Corp., Kokomo, Ind.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Roebling's, John A., Sons Co., Trenton, N. J.
Tennessee Coal, Iron & R. R. Co., Birmingham, Ala.
U. S. Steel Export Co., New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Music
American Brass Company, The, Waterbury, Conn.
American Steel & Wire Co., Cleveland-Chicago, New York.
Columbia Steel Co., San Francisco, Calif.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Malin & Co., Cleveland, Ohio.
Webb Wire Works, The, New Brunswick, N. J.
U. S. Steel Export Co., New York, N. Y.

WIRE—Needle
Webb Wire Works, The, New Brunswick, N. J.

WIRE—Nickel & Nickel Alloy
International Nickel Co., Inc., New York, N. Y.

WIRE—Nickel Silver and Phosphor Bronze
American Brass Company, The, Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.
Malin & Co., Cleveland, Ohio.

WIRE—Non-Ferrous to Specifications for Special Purposes
American Brass Company, The, Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.
North American Philips Co., Inc., New York, N. Y.

WIRE—Spring
American Brass Company, The, Waterbury, Conn.
American Steel & Wire Co., Cleveland-Chicago, New York.
Bethlehem Steel Co., Bethlehem, Pa.
Columbia Steel Co., San Francisco, Calif.
Continental Steel Corp., Kokomo, Ind.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
U. S. Steel Export Co., New York, N. Y.
Webb Wire Works, The, New Brunswick, N. J.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Stainless Steel
American Steel & Wire Co., Cleveland-Chicago, New York.
Columbia Steel Co., San Francisco, Calif.
Firth Sterling Steel & Carbide Co., McKeesport, Pa.
Tennessee Coal, Iron & R. R. Co., Birmingham, Ala.
U. S. Steel Export Co., New York, N. Y.
Webb Wire Works, The, New Brunswick, N. J.

WIRE—Steel—Also Coppered Steel—Also Galvanized Steel
Bethlehem Steel Co., Bethlehem, Pa.
Continental Steel Corp., Kokomo, Ind.
Johnson Steel & Wire Co., Inc., Worcester, Mass.
Jones & Laughlin Steel Corporation, Pittsburgh, Pa.
Keystone Steel & Wire Co., Peoria, Ill.
Laclede Steel Company, St. Louis, Mo.
U. S. Steel Export Co., New York, N. Y.
Wickwire Brothers, Inc., Cortland, N. Y.
Youngstown Sheet & Tube Co., Youngstown, O.

WIRE—Steel, Electrolytically Coated
Kenmore Metals Corp., Jersey City, N. Y.

WIRE—Straightening and Cutting
Pittsburgh Cut Wire Co., Pittsburgh, Pa.
Wickwire Brothers, Inc., Cortland, N. Y.

WIRE—Tungsten
North American Philips Co., Inc., New York, N. Y.

WIRE—Zinc
Platt Bros. & Co., The, Waterbury, Conn.

WIRE CLOTH—Industrial
Roebling's, John A., Sons Co., Trenton, N. J.
Wickwire Brothers, Inc., Cortland, N. Y.

WIRE WEAVING—Non-Ferrous
American Brass Company, The, Waterbury, Conn.
Hudson Wire Co., Ossining, N. Y.

WRAPPING PAPER—Creped
Angier Corporation, The, Framingham, Mass.
Crepe-Kraft Company, The, Division National Waterproof Papers, Inc., Newark, N. J.

YARNS & TAPES—
Belding, Heminway, Corticelli Co., New York, N. Y.
Du Pont de Nemours, E. I., Co., Wilmington, Del.
Glass Fibers, Inc., Waterville, Ohio.
Owens Corning Fiberglas Corp., Toledo, Ohio.
Percelay Yarn & Textile Co., Pawtucket, R. I.
Twitchell, E. W., Philadelphia, Pa.

YARN TESTERS—
Scott Testers, Inc., Providence, R. I.

The WATSON MACHINE COMPANY

ESTABLISHED 1845

PATERSON 3, NEW JERSEY, U.S.A.

WATSON

ELECTRICAL WIRE AND CABLE, WIRE ROPE AND CORDAGE MACHINERY

RIGID FRAME HORIZONTAL STRANDERS - TYPE RH

Outstanding producers of soft copper and aluminum multi-layer concentric strands of round or sector shape.

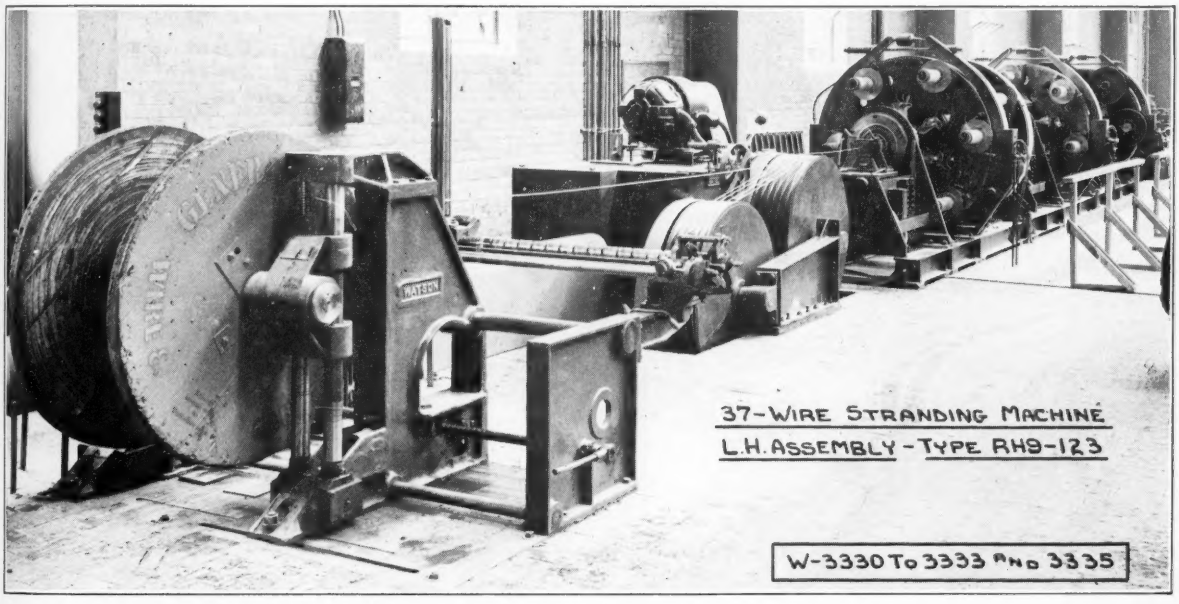
Much cheaper and far more efficient than planetary machines of comparable utility.

Heads are all steel, ball bearing construction and maintenance is practically nil.

Open construction, overhung spool mount, automatic stops, etc., reduce down-time to an absolute minimum to which "shaftless" takeups also contribute. Spool change down-time on largest size heads RH9 (22"-650# spools) has been clocked at less than 2 minutes per spindle.

Available in all sizes and groupings with auxiliaries to meet any practical rigid frame stranding requirements. Smaller sizes of single disc, largest sizes of multi-disc (shown here) construction.

Roll-over equipment on heads for pre-spiraled (preformed) sector strand can, where required, also be supplied.



Above machine, loading 22" spools, with complete lead-thru, will strand up to 37-wire conductors single pass and other constructions, to 127-wire by multi-pass. As shown with 10-ton pull, non scuffing "tilted" capstan and with "shaftless" 6-ton takeup. Maximum (over takeup reel) machine length —66 feet.

Remember

EF

builds
Gas, Oil and
Electric Furnaces

and recommends

without prejudice

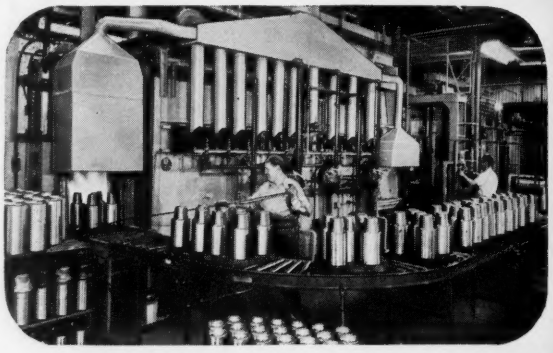
the one that suits

your requirements

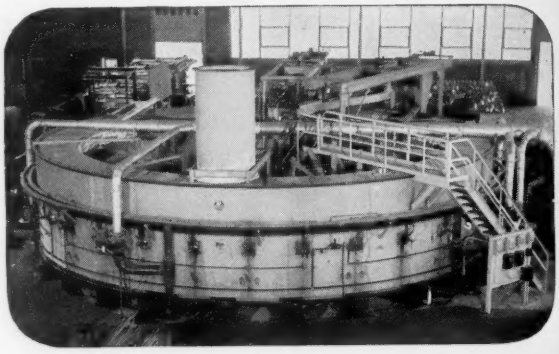
best!

Because we build all types of batch and continuous furnaces—in sizes to meet any production requirement—gas-fired, oil-fired, and electrically heated—we can recommend *without prejudice* the type—the size—and the method of heating—that suits all phases of *your particular* problem best.

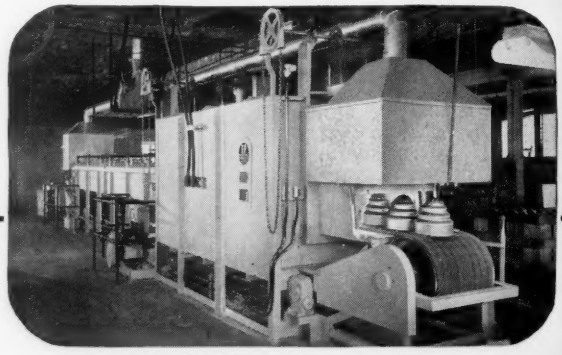
On your next annealing, brazing, hardening, solution treating, carbon restoration, carburizing or other heating or heat treating problem—investigate EF developments—available only in EF furnaces. We solicit your inquiries.



Gas-fired EF radiant tube continuous pusher-type furnace used for gas carburizing and other heat treating processes requiring several widely different cycles.



Oil-fired EF rotary furnace equipped with automatically controlled hydraulically operated charging and discharge mechanism —heats 35,000 lbs. of large billets per hour.



Electrically heated EF wire mesh belt conveyor furnace . . . for brazing, annealing, sintering, and other heat treating of aluminum, brass, copper and steel products.

EF

Gas-Fired, Oil-Fired and Electric Furnaces

for any Process, Product or Production

THE ELECTRIC FURNACE CO.

WILSON ST. at PENNA. R. R. *Salem - Ohio*